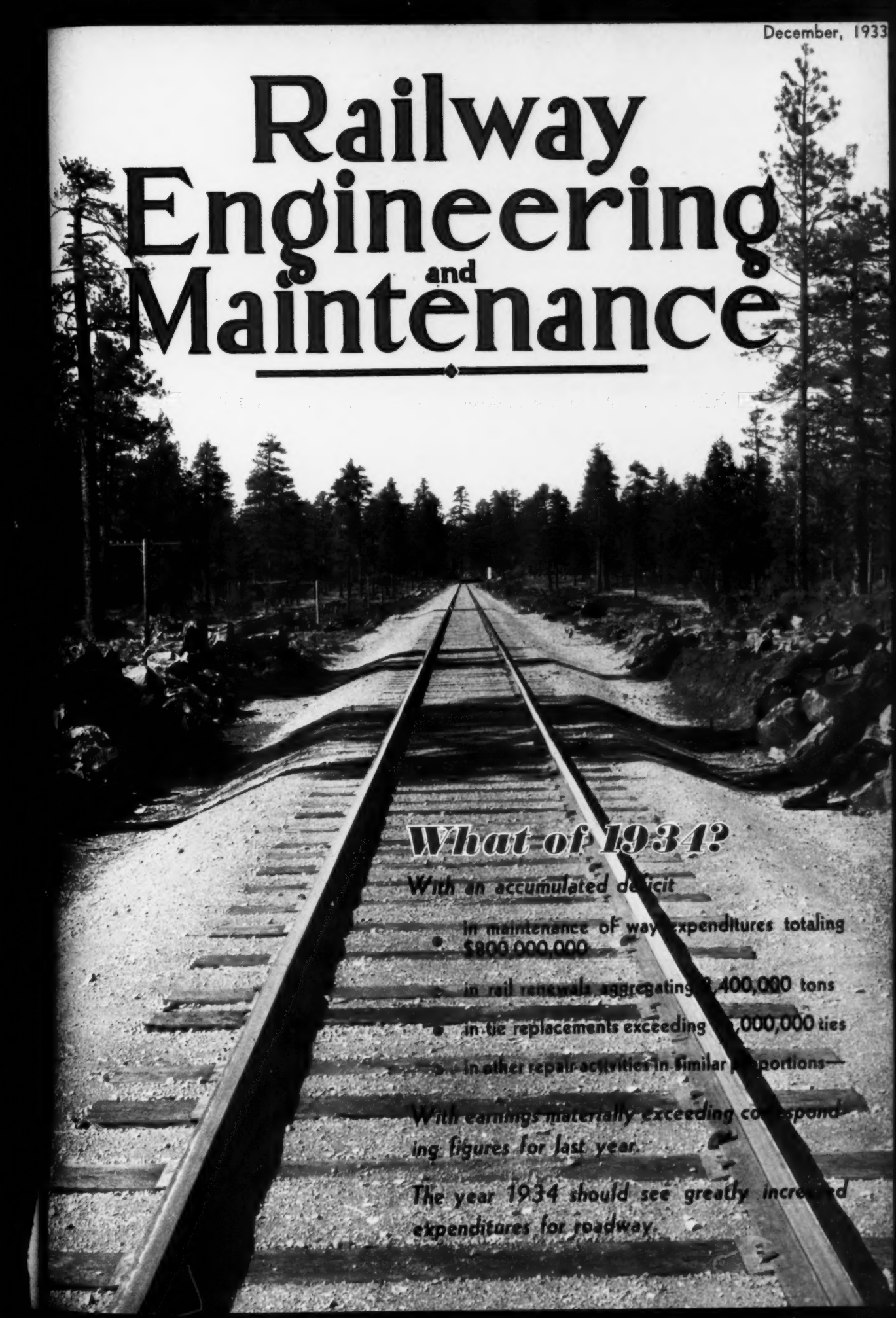
December, 1933

Railway Engineering and Maintenance


What of 1934?
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in maintenance of way expenditures totaling $800,000,000
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in tie replacements exceeding ,000,000 ties
in other repair activities in similar proportions—
With earnings materially exceeding corresponding figures for last year.
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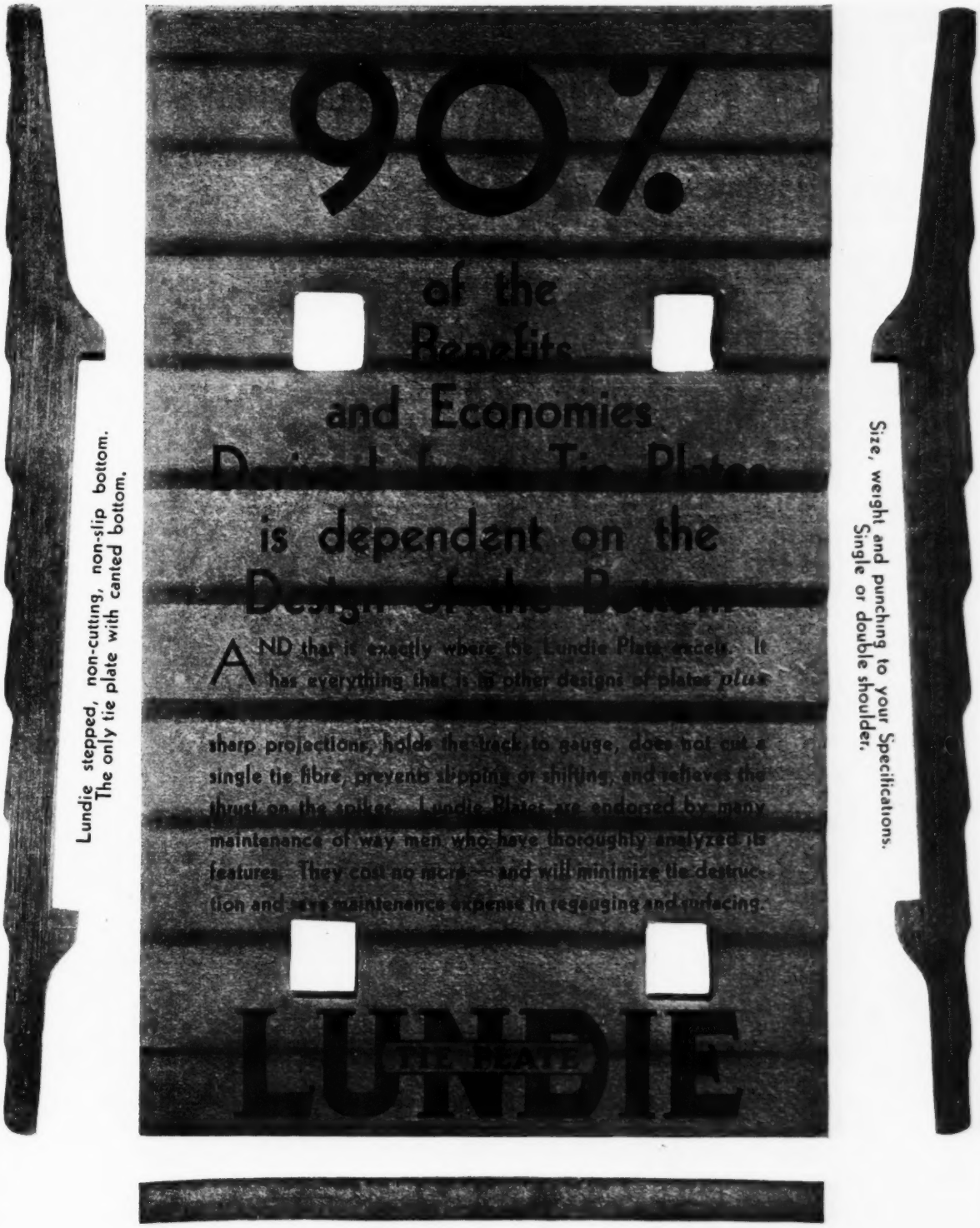
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No. 60 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Five Years

November 30, 1933

Dear Reader:

This letter completes five years' informal chats with you about the more intimate details of our relations, for it was in January, 1929, that the first of these letters appeared on this page. In that original letter I said that to me the most interesting thing about a railroad was not the locomotives or the tracks, but the men who construct and maintain them. In like manner, it was felt that you might welcome a more intimate acquaintance with those of us who bring Railway Engineering and Maintenance to you each month.

In that original letter, I said, "I want to tell you something of ourselves, of our problems and of our ideals in a less formal and more intimate way than would be appropriate in the editorial pages. In short, I want to develop such an intimate and friendly relation with you that you and I, although we may never meet, may come to regard each other as friends and take a friend's interest in each other."

In keeping with this objective, you will recall that these letters have from time to time dealt with our staff and how we go about collecting the information that comes to you each month. They have described our loyal group of editorial contributors. They have pointed out to you the cost of preparing the magazine which you receive and of the small proportion of this cost that is covered by the subscription price. They have expressed the pride that we take in the large percentage among you who renew your subscriptions year after year.

Other letters have cited evidences that have come to us of the thoroughness with which you read the advertisements of equipment and materials designed for your use. You have been told of the manner in which Railway Engineering and Maintenance aids in the developing of markets for new materials and equipment. Quotations have been made from the voluminous correspondence that we have with readers on railways from distant countries, as well as those at home. In brief, I have tried to give you a picture of our work and of your reaction to it as we see it.

Have you enjoyed these letters? Have they given you a better appreciation of the efforts that enter into the production of your magazine? Have they aroused in you a little keener interest in us? In other words, have these letters created a little closer bond between us? If so, they have been worth while.

Yours sincerely,

Elmer T. Howson

ETH*JC

Editor

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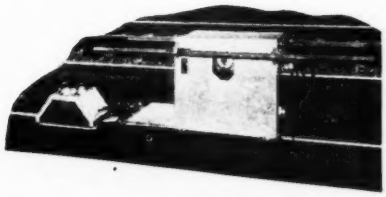

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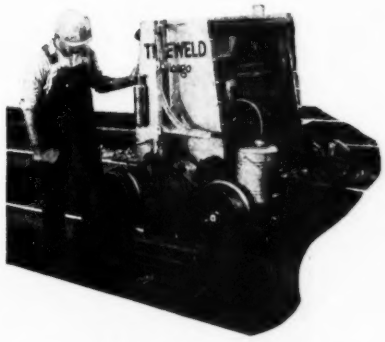

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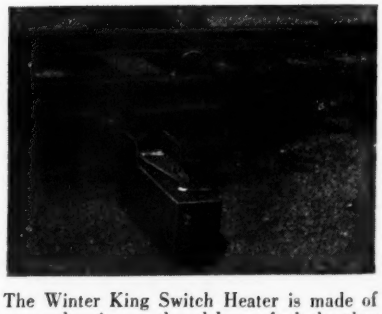

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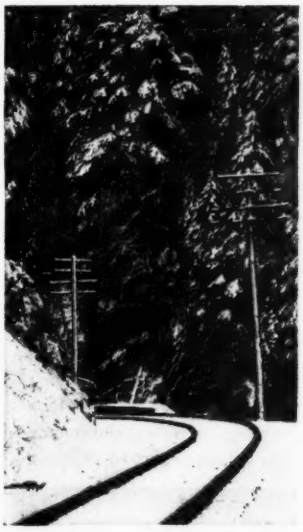

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Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

DECEMBER, 1933

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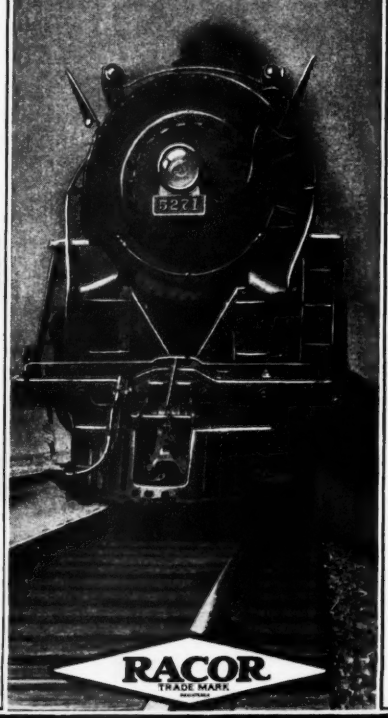

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Railway Engineering and Maintenance

TRAFFIC

Every Employee a Salesman

IT IS not many years since the railways enjoyed a monopoly of transportation service. They provided the only agency for the carriage of passengers and freight. Those who desired to travel or to ship used the railways as a matter of course. In those days there was little need for the railways to sell their services—those who were in need of them came to the roads, for there was nowhere else to go. Furthermore, not infrequently more traffic came to the railways without solicitation than they were able to handle, and congestion, car shortages and embargoes were accepted as a matter of course in every spurt of industrial activity. Under such conditions, there was little necessity for maintenance of way and other employees of the railways to concern themselves with the solicitation of traffic from those with whom they came in contact in their communities, for the railways got it anyway.

It is not surprising, by reason of these conditions, that there developed among railway employees an attitude of indifference to traffic—frequently including some of those within the traffic department itself. Even today not a few of these men whose task it is to create business for the railways are little more than information bureaus with a "come and get it" attitude.

Conditions Have Changed

But the conditions confronting the railways have changed. They no longer have a monopoly of transportation service but are confronted with competition on every hand. The private automobile, the bus and the airplane are taking millions of passengers from the railways, while the truck and the waterway are making similar inroads on freight. The decline in railway revenues from these sources, exclusive of the decrease resulting from the present temporary slackening in business in general, exceeds a billion dollars a year and it is growing steadily. This is a trend that can no longer be ignored. It has been ignored too long already.

This problem is no longer solely that of the traffic department. It is the concern of every railway employee. Its continuation constitutes a menace to the security of his employment. The last four years have been abnormal in that revenues have been reduced by the universal decline in all industry. These years have driven home to every employee, however, the fact that a railway can spend for wages only that income which it receives in payment for transportation services rendered. It cannot spend more and as its traffic declines, its payrolls must be reduced correspondingly, even though this leads to part-time work for many employees and the laying off of others.

While the depression has contributed largely to the decline in railway employment during recent months, this decline would have prevailed in large degree if there had been no abnormal depression, by reason of the diversion of traffic to competing agencies of transportation. Because of this very direct relation between the volume of traffic and the size of his paycheck and that of his fellow workmen, every employee has a very direct interest in securing for his railway all of the traffic possible. He can no longer maintain a "come and get it" attitude. Neither can he leave the task of traffic solicitation to the traffic department, for his own job is at stake.

What Can Employees Do?

What can an individual employee do, especially one in the maintenance of way department? He can aid in several ways. In the first place he can so fully inform himself regarding the handicaps with which the railways must contend in competing with highway vehicles, with airplanes and with the waterways that he can acquaint his neighbors with the facts and build up a sentiment for the correction of these unfair conditions. He can point to the subsidies which the state and national governments are giving to highway transportation agencies by providing them with roadways at rentals grossly inadequate; he can cite the huge payments made to the aviation lines for the carriage of mails, which enable them, as a result, to lower their passenger rates far below actual cost; he can show that navigation on the inland waterways is commercially possible only by reason of government aid through the provision and maintenance of the channels and, in fact, by the government entering into the transportation business itself and paying the deficits from funds collected from public taxation. He can show also that all such subsidies add to the taxes paid by the general public for the benefit alone of those who use these services.

Much has already been accomplished in building up a public sentiment for the correction of these inequalities by railway employees acting individually as well as collectively in focusing attention on this situation. Much more still remains to be done, however.

Railway employees can also render valuable service by becoming salesminded. Without in any way neglecting their regular duties or usurping the responsibilities of traffic solicitors, they can become more alert to discover potential business and secure it for their road. By pre-

senting the arguments of security and comfort to a neighbor who is considering a bus journey, by urging the reliability of rail transportation to a farmer along the right of way who is about to ship his stock to market by truck, he can bring back to the roads much traffic that is now going to other agencies. This has been the objective of the "Booster" and Ship By Rail clubs that have been organized so effectively on a number of roads, crystallizing as they do in the minds of individual employees the thought that they promote their own personal interests when they secure traffic for their roads. That such activities can be made of much value to a road is shown by the record of the St. Louis-San Francisco, whose Booster clubs, during the first six months of this year, were credited with securing for the railroad 1,878 carloads and 6,619 less-carload shipments of freight, and 573 passengers, much of which traffic might otherwise have been lost to this road.

A New Day

We have emerged into a new day in railroading. This is evidenced especially in the competition that confronts the railways. This competition is here to stay, although it will be placed on a more fair and equitable basis when the public becomes sufficiently aroused to demand such action. Even when all inequalities are eliminated, however, it will still be necessary for the railways to sell their services more aggressively than they have done to date. Furthermore, under the system of regulation to which the railways are subjected, the margin between income and expense is so small that every fluctuation in income is inevitably reflected in payrolls. Every employee has a very direct personal interest, therefore, in actively seeking every bit of traffic that he can secure for his road. In brief, every railroad employee should become a salesman of the commodity which his company sells.

STORMS

Adequate Preparation is Half The Battle

ALTHOUGH the forecasting of weather by the season or the year is an age-old practice, few people of intelligence have confidence in predictions other than those conducted by the weather bureaus of the various civilized countries, and even these, which make any pretense to forecast for more than 48 hours in advance, are not always correct. While their predictions afford a fairly good index of what may be expected, for example, a snow storm, they do not tell whether there will be three inches of snow or eighteen inches.

This lack of definite advance information is not as serious a matter for the maintenance of way officer as it was ten, or even five, years ago, because he is in a better position to meet these emergencies. Fortunately, or rather, unfortunately, he can recruit all the men he needs on very short notice, and many of the large terminals are now equipped with snow melting appliances that make it possible to cope adequately with storm conditions that would completely overwhelm almost any number of men with brooms and shovels.

But whether the storm is to be fought with machinery or with men, it will not be fought successfully unless adequate preparation has been made. If the officer in charge must depend on manual labor, he must know where to get his men quickly and just how and where he will use them. If he expects to depend on snow melting equipment he must know that it is ready for use. Adequate preparation for fighting snow storms is as necessary today as at any time in the past.

WATER FAILURES

Cold-Weather Troubles May Be Due to Neglect

THE season is approaching, and in some sections is already at hand, when cold-weather troubles may be expected at water stations. These include frozen tank valves, water columns and tank spouts, accumulations of ice on the tracks, ice-clogged intakes, etc. Cases have been known where tanks have collapsed as a result of the formation of thick ice over the upper surface of the water in a full tank to be followed by the emptying of the tank, with a resulting difference between the inside and outside air pressures that was sufficient to crush the tank shell.

While severe winter conditions make the operation of many water stations difficult, and sometimes the most careful precautionary measures do not prevent emergency conditions at individual stations, the test of the management of the water-supply activities on a division or a system is the infrequency with which winter water failures occur or impend. Water service departments are organized for one purpose only—to provide dependable supplies of satisfactory water, mainly for locomotive boiler use. They can justify themselves only to the degree that the supply remains dependable. Ignoring the question of quality, ample supplies from wells, reservoirs or streams may have been provided, but if the delivery of the water cannot be completed by reason of some failure of the equipment, the net result will be the same as if the failure had occurred at the source. The providing of the supply may not be entirely within the control of the local water-supply organization, but the functioning of the delivery equipment is its special responsibility.

Where water is taken directly from tanks, a hard, cracked or worn seat in the outlet valve will result in leakage. In cold weather, even a small leak, if neglected, may lead to the accumulation of sufficient ice in the outlet pipe to impair delivery or it may fill the tank spout with ice, the latter condition being particularly troublesome. Likewise, failure to protect water-column valves from frost or to provide free drainage from the pit may result in a water failure and cause serious delays to trains. In some instances water is wasted on to the track through improper operation of water columns. Where this occurs, failure to provide drainage will result at all times in unsatisfactory track conditions, and, in the winter, in heaving and troublesome accumulations of ice.

These are only a few of the troubles that may occur at water stations in extreme weather. Neither those that have been mentioned nor others that have come within the experience of most water-service officers in north-

ern sections are unavoidable. For this reason, when they do happen, an investigation should be made as soon as service is restored to determine whether they have resulted from improper operation or neglected maintenance. In any event, the maintenance forces are placed on the defensive by every case of failure of water delivery that can be traced to ice conditions.

BALLAST CLEANING

Is This Subject of Much Importance?

A MAINTENANCE of way officer was asked recently what importance he attached to ballast cleaning as compared to various other items of track maintenance work. His reply was that clean, free-draining ballast was of such importance to a sound, dry, smooth-riding and economically-maintained track, that needed ballast cleaning should be one of the last of the major maintenance items to be curtailed when reducing expenditures, and one of those to be curtailed the least. Records of the amount and character of the ballast cleaning done on this officer's territory during the depression show that he has acted in full accord with this opinion. Year after year, in spite of reduced budgets, when the limited amounts of money that were available could have been spent profitably in so many ways, ballast cleaning has continued to assume a prominent place in the maintenance program, and, in fact, has been carried on to a larger extent during the last two years than in any previous years.

This attitude stands out in marked contrast with that prevailing on the roads of the country as a whole, for ballast cleaning has been severely curtailed during the last three years, and particularly during the last two. Yet, there has been a growing appreciation among maintenance men of the value of a free-draining roadbed, which can be obtained, with stone ballast, only by periodic cleaning with effective screening equipment. Fortunately, there have been outstanding developments in this class of equipment and in ballast cleaning methods, which is evidence in itself of the increased importance that is being attached to this class of work. Whereas hand cleaning used to cost from 65 to 75 cents a cubic yard of material handled, a cost for more thorough and effective machine cleaning, including all expenses, in excess of 20 to 25 cents a cubic yard is today considered out of line, while with some of the latest equipment, under favorable conditions, the cost has been reduced materially below these figures.

Taking advantage of the equipment available, many roads have continued needed ballast cleaning on a sizeable scale. To this extent their tracks will go through the present winter in better condition and with less attention than would have been required otherwise. This should afford some satisfaction, but with a sizeable backlog of track to be cleaned on most of the roads which have stone ballast, and with the additional track maintenance which this will necessitate until corrected, there should be little satisfaction among maintenance men until they get their full stone ballast mileage back in a reasonably clean condition.

PAINTING

Neglect in This Field Must be Made Good

A BRIDGE, a station building or a water tank can suffer from a lack of paint for a long time without loss of effectiveness in the service it performs. That the railways have taken full advantage of this truism is evident from wholesale abandonment of painting during the last three years. Realizing that painting could wait, they have allocated the limited funds available for the maintenance of tracks and structures to those operations that are most effective in keeping the properties in a safe and usable condition for the operation of trains.

In the meantime rain, sun, wind, salt mists, brine drippings and coal smoke have kept up their destructive activity on metal and wooden surfaces, the effect of which increases in progressive ratio as the paint films lose their protective powers with advancing age. As a consequence, the postponement of repainting schedules has resulted not merely in deferring expenditures of fixed amounts until some later date, but in imposing the certainty of outlays in appreciably larger volume when the work is done eventually. In fact, failure to provide protection for some structures will lead to damage that no amount of painting in the future can correct.

It is evident, therefore, that the situation with respect to painting is rapidly assuming serious proportions. Obviously, such a generalization cannot be applied to the structures of all railways with equal force. Some railways, of course, have kept their structures in fair condition, while on others, the situation with respect to painting has reached an emergency stage, under which any work done must be so scheduled as to give earliest attention to those structures that are approaching the point of permanent deterioration. But the time has arrived when all roads must give the problem urgent attention.

An important point to be considered in any painting program is the necessity for expending more than the normal proportion of the total outlay for painting, in the preparation or cleaning of surfaces. Railway officers in charge of painting have, in recent years, given careful consideration to the use of the sand blast and other mechanical means of cleaning metal surfaces and have applied these methods as conditions seemed to warrant, but in the face of a greater volume of work of this kind, economy in the removal of scale and rust assumes a greater importance than has been the case heretofore. The entire problem of painting demands careful study.

SEPTEMBER INCOME—For September the Class I railways of the United States had a net railway operating income of $60,936,370, which was $11,988,325, or 25 per cent, larger than their net operating income for September, 1932, according to figures compiled by the Bureau of Railway Economics. The income for September, 1933, represented a return, on an annual basis, of 1.98 per cent on the property investment of these roads. Operating revenues for September amounted to $292,147,176, as compared with $269,147,176 in September, 1932, an increase of 8.4 per cent. For the first nine months of the year the Class I railroads had a net railway operating income of $340,973,877, as compared with $197,832,444 in the same period of 1932.

A Substantial Part of the Rail Should Be Available for Winter Laying

884,000 Tons of Rail—How Will It Be Laid?

Determination of the methods and equipment that will produce the greatest efficiency is now the important problem before the railroads

WHAT disposition will the railways make of the more than a million tons of rail and fastenings which they have indicated that they will purchase in response to the suggestion of President Roosevelt and Federal Co-ordinator of Transportation Joseph B. Eastman? How will it be distributed? What methods will be employed in applying it? Will a substantial part of it be laid during the winter? What will be done with the rail that is released? What collateral work, such as ballasting, surfacing, renewing ties, etc., will be necessary? What effect will these activities have on unemployment?

Some of these questions arise because of the avowed purpose back of the purchase to stimulate employment. Others occur by reason of the fact that, according to the best estimates available, the present deficiency in normal rail renewals approximates 3,400,000 tons, or nearly four times the amount of the rail included in the recent orders. In other words, for every ton of rail presently to be laid, there still remains a need for three additional tons to bring the rail condition of the railways as a whole back to that of 1928-29. This latter statement, while correct for the railways as a whole, will not apply with equal accuracy to individual roads. One reason for this is that some roads have been carrying quantities of new rail for several years because of unwillingness to incur the expense incident to applying it and have this rail on hand to add to the tonnage they are now purchasing. Other roads, on the contrary, have not curtailed their rail renewals seriously. Despite these variations, the fact remains that, in general, rail renewals have been severely curtailed during each of the last four years. Obviously, this fact will have a direct bearing on the distribution of the new rail. While not so obvious, it will also affect the methods to be employed in laying it. It will also go further and, together with other factors, influence the disposition of the rail that will be released by the program.

In view of the expressed purpose to give immediate employment to the maximum number of men, it is to be assumed that the manufacturers of both the rail and fastenings will make as prompt deliveries as possible until the orders are filled. A substantial part of the new material should be available for application, therefore, within a few weeks. On the other hand, it is estimated that under the most favorable conditions these orders, when placed, will require the mill capacity of the country for four months, so that it is unlikely that the final rollings can be completed before some time in the spring or early summer of 1934.

In the past, there has been a sharp division of opinion among maintenance officers on northern roads with respect to the practicability of laying rail during the winter. In many sections of the South, however, the winter season affords better working conditions than the summers with their long periods of high temperatures. At this season, also, labor has normally been more plentiful, and in this section the practice has long been established of completing the heavier tasks of maintenance, including rail renewals, during the winter months. For these reasons, as well as because there is at present so large a surplus of labor, it is to be expected that the southern roads will begin laying their rail as soon as it is received and continue until deliveries are completed.

In the North, an increasing number of roads, notably the Delaware & Hudson and the Lehigh Valley, have found the winter season no bar to laying rail. This practice has not been universal, however. For this reason, the laying of rail during this season will be a new experience for some of those roads that are involved in the recent purchases. Yet, despite the handicaps of winter work, the urgent need for providing immediate employment will, in all probability, induce many officers to waive

their objections and lay the rail at this time, although their judgment may oppose it.

Under normal conditions rail programs are prepared and the rail is distributed in an orderly manner. Ordinarily, little "patching" is permitted, except at points of excessive wear, as on curves and approaching places where train stops are frequent. On the contrary, most of the rail is laid in continuous stretches, sometimes ranging up to 25 miles or more. In view of the present marked deficiency in rail renewals, the forthcoming distribution is not likely to be so orderly.

The reason for this lies in the fact that, to obtain the maximum benefit from the new rail, it is probable that most roads, particularly those that are buying a relatively limited tonnage, will so distribute it as to insure that the greatest amount of badly worn rail will be replaced. In not a few instances this will lead to a considerable part of the new rail being laid in short stretches or used for patching. Despite the fact that this method of distribution will be followed to a greater extent than usual, it should not be assumed that the total amount of rail involved in these purchases will be distributed and laid in this manner, for the tonnage for which orders are being placed is sufficient to lay about 5,000 track miles.

Disposition of Released Rail

Under ordinary conditions, the percentage of rail released from main-line tangent tracks that is not suited for use in less important main tracks is almost negligible, being confined largely to individual rails in which defects are discovered and to occasional rails that are cut for closure or other reasons. Owing to the present long deferred renewal of much of the rail now to be released, it may be expected, however, that a larger proportion of this rail will not be suitable for relaying in secondary main tracks or in branch lines. If we assume that 20 per cent will not be suitable for further use in main tracks, there will still be approximately 4,000 miles of released rail available for replacing main-track rail of lighter section or greater wear.

Also, recent developments in the maintenance of rail, particularly the practice of reconditioning the ends by welding, are beginning to have an influence on the disposition of released rail. Heretofore, it has been a common practice to saw from 12 to 24 in., and even more, from the ends of badly battered rails and redrill them before they are relaid, to insure smooth-riding track and reduce the cost of joint maintenance. Owing to the advances that have been made in welding equipment and practices, the railways now have available a process whereby the rail ends can be reconditioned after they are re-applied in the track, with results as satisfactory from the standpoints of riding quality and joint maintenance as if they had been sawed.

This process has several advantages which have a direct bearing on the disposition of the released rail now under consideration. The fact that the reconditioning of the rail ends can be done in the track after the rail is relaid makes it available for use immediately upon its release. This fact makes it unnecessary to ship the rail to the mill for resawing and thus eliminates the loss of time as well as the cost involved in shipping and rehandling, which are a necessary accompaniment of the resawing process. When the rails are resawed, there is also a loss, represented by the crop, of from 7 to 10 per cent of the original length of the rail, which loss is avoided by the use of the welding process. If the welding process is employed for reconditioning this 4,000 track miles of released rail under discussion, from 300 to 400 more track miles of rail will be available for use than if this rail is resawed to make it useable.

Following logically the distribution of the rail, decision must be made with respect to the organization and equipment for laying it. The method of distribution will, of course, have a distinct influence on both the organization and the tools to be employed. Where a road is in position to lay its rail in relatively long stretches, the need for economy is so urgent that it cannot afford to do otherwise than employ the most efficient methods. Where it must be distributed over a large number of short stretches, the gang organization for each locality will, of necessity, be small and temporary in character and cannot, therefore, be handled with anything like the efficiency of the larger and more permanent gangs. For the larger gangs, the fullest measure of efficiency will require that the operation be mechanized in all of its phases, from the withdrawal of the spikes to release the old rail, through the preparatory activities and the actual laying, to the driving of the spikes to secure the new rail.

Is it to be expected that new or unusual methods will be employed to lay the rail? If not, have refinements of importance been developed during the last three or four years which represent marked advances in the application of former methods? In general, it is to be expected that there will be few marked departures from the practices of recent years. Few roads have laid enough rail during the last four years to have developed and tested new or unusual methods under actual working conditions. If

Application of Lagged Tie Plates Calls for a Special Procedure

any such plans have been worked out, it is unlikely that they will be tried out at this time because of the conditions under which the rail is being purchased and applied.

On the other hand, some roads have been making an intensive study of rail-gang organization and of refinements in methods which will increase the efficiency of their former practices. It may be accepted as a certainty, therefore, that some changes in former methods will occur. At any rate it is a safe prediction that the average performance of all of the roads will be on a higher level of efficiency. How will this be brought about? Largely through more effective supervision and a more thorough mechanization of all of the component activities that are comprised in the general operation of laying rail.

It has been so short a time since the laying of rail was entirely a hand operation that there has been no opportunity to standardize practices, nor has there been any real need for doing so. During the last decade machines for laying rail and performing incidental work have been

devised, or improved radically, with almost bewildering rapidity. As a result, while the same general methods are followed on all roads, there is a wide range in the details of the practices that have been developed by individual roads. Since there is this variation, it will be of interest to review the practices of a few of the roads that have been foremost in developing distinctive rail-laying methods. When this is done, however, it becomes apparent that there are no basic differences between them. Such variations as do exist in their practices can be traced to differences in physical, climatic or traffic conditions; to differences in the standards of maintenance or in the view point of maintenance officers; and often to the degree to which their rail-laying operations are mechanized.

Distinctive Practices Have Been Developed

For a number of years the Chicago, Milwaukee, St. Paul & Pacific has been an exponent of large system rail gangs. This attitude is based on the belief that by properly organizing such gangs and equipping them with power machines and tools the operation can be kept in better balance. It is the contention of this road also that a gang that performs only one class of work soon becomes expert in the use of the machines with which it is equipped and thus is able to use them more intensively, with the result that its production, as well as the quality of the work remains at or near the maximum.

Rail gangs on this road are fully equipped with power machines, including spike pullers, adzing machines, rail cranes, bolt tighteners and spike drivers. They also include a unit for heat treating and cross grinding the ends of the new rail. The rail, fastenings and turnout material are distributed well in advance of the rail laying. In advance of the gang as it progresses, the fishing surfaces at the ends of the rail are oiled and the angle bars are attached with one bolt only partly tightened. Where new tie plates are required, they are also distributed in advance of the first unit. This unit pulls the spikes and unbolts the joints. The old rail is then thrown out by hand, the tie plates are removed, the tie plugs are inserted and the ties are cleaned of ballast and grit which might affect the adzing machines. Following this, a battery of adzing machines adzes the ties, after which the new tie plates are placed. The rail is then set in place with a rail crane, requiring the services of three men, one to operate the crane, one tong man and the third to "heel" the rail into position. The subsequent operations of bolting and spiking, except gage spiking, are also performed with power tools. With a gang of this type, an average of 20,000 lin. ft. of rail is laid per day where traffic is diverted.

In contrast with the use of system gangs, for a number of years the Pennsylvania preferred to employ division gangs which were similarly equipped with power machines and tools. On this road all rail sections from 100 lb. to 130 lb. have the same width of base, so that heretofore it has been unnecessary to replace the tie plates, provided the old ones were not too light, and this has automatically done away with the necessity for adzing the ties. The later 131-lb. section, which is now being laid over a large part of the mileage of this system, and the 152-lb. section which it is also using, have wider bases and, therefore, require a change of tie plates and the adzing of the ties.

More recently this road abandoned the use of division gangs and has been laying its rail with regional gangs. With this method, the present plan calls for an organization consisting of 35 men, including 1 foreman, 1 assistant foreman and 1 machine operator, which is used as the nucleus for the larger gang that is required. The remainder, which is needed for the economic operation of the machines that are used, is provided by the division on which the rail is being laid. This unit consists of 52 men, including 1 foreman, 1 assistant foreman, 1 work equipment engineer and 3 machine operators. In addition, 1 general foreman, 1 clerk and 1 maintenance of way inspector are assigned permanently, making a total of 90 men, of whom 78 are laborers.

Power equipment is provided for every operation for which such equipment is available, and includes 4 crawler cranes, 1 locomotive crane, 1 rail crane, 4 spike pullers, 4 adzing machines, 2 grinders for sharpening cutting bits, 2 air compressors, 6 spike drivers, 6 track wrenches, 1 cross grinder and 2 motor cars. The crawler cranes and the locomotive crane are provided as aids in distributing new material and picking up the released material. One of the compressors and four of the pneumatic track wrenches are assigned to uncoupling the joints of the old rail. In addition to the force engaged specifically in laying the rail, 17 men are assigned to the distributing train and 20 to picking up the released material, while 4 signalmen do the necessary bonding, making a total of 131 men.

As on the Milwaukee, the Pennsylvania lays one side of the track at a time, following the same general sequence that must be observed in any rail renewal operation, but doing only such work by hand as is necessary by reason of lack of equipment to perform these tasks. Each of these gangs works exactly eight hours, and at the end of the day has used all of the material that has been distributed during the day and has also picked up all released material, leaving the track clean and ready for traffic. The maximum amount of rail laid in one day has been 627 rails 39 ft. long, or at the rate of 78 an hour.

Probably no road has more fully mechanized its rail-laying operations than the Boston & Maine, which also employs power machines and tools for every phase of its work for which such equipment is available. On this road every twentieth joint is broken on tangent and every tenth joint on curves to facilitate the barring out of the old rail. The next operation is the withdrawal of spikes, for which power spikes pullers are used. The succeeding operations of barring out the rail, removing the plates, inserting and driving tie plugs and cleaning the ties of ballast and grit are performed by hand. Immediately thereafter a battery of power adzers prepares the ties for the new ties plates, which are placed by hand.

Next in order comes the rail crane for setting in the rail, and this is followed in sequence by the assembly of the joints, in which power bolt tighteners are used; by the gaging, a hand operation, and spiking with power spike drivers; by the application of anti-creepers, another hand operation; and by the signal bonding, in which either welding equipment or power drills are employed, depending on the type of bond used. With a full complement of power machines and tools, gangs on the Boston & Maine have been able to average 68 rails an hour in laying a long stretch of track. Under the most favorable conditions, this has been increased to an average of 82 rails an hour for one day.

Details Vary Widely

On some roads using tie plates that are lagged to the tie independent of the rail fastening, it is the practice to organize a special unit which applies the tie plates in advance of the remainder of the rail-laying forces, the latter following the same general procedure as already discussed. Where the new form of track construction is installed, one or more specially organized units, which are equipped with power appliances, follow the bolting and

gaging units to lag the plates to the ties. One road in particular, which now lags all of its tie plates, considers it important to defer the lagging operation for a specified period, sometimes as much as three or four months, to insure that the plates are well set on the ties under traffic, especially where a heavier rail section has been applied.

This road does not plug the spike holes in ties that appear to be nearing the end of their service life, while the lagging is deferred until the ties are renewed and the track is surfaced. Owing to the length of the tie plates, power adzers are not employed, but the ties are scored and the adzing is done by hand. Creosote is then applied to all cut surfaces, and the lag screws are dipped in creosote before they are tapped in. On this road, as on several others, the fishing surfaces are swabbed with oil immediately prior to the application of the joint fastenings to insure that no dirt and grit will cling to the oiled surfaces, as is possible when the oil is applied before the rails are set into the track.

This Method Is Becoming Obsolete

Other practices which are gaining favor are the heat treating and cross grinding of the ends of new rail as it is applied. A limited number of roads are now doing this regularly, while others are now experimenting along this line.

Practices with respect to uncoupling the rail vary, in some instances, with the type of equipment employed since with some machines the nuts must be removed while the rail is yet in the track, while with others they can be run off with substantially the same facility after it is lined out. As a result, some roads uncouple all joints before the rail is thrown out and line out the individual rails with bars or set them out with the rail crane; others break joints at specified intervals and throw the rail out in strings; while still others do not break joints, but bar the rail out in continuous strings from closure to closure.

Where the new rail has the same width of base as the old, it is customary to pull only one line of spikes. If double-shoulder tie plates are in service, it is not so easy to line out the old rail since it must be tilted and lifted clear of the unspiked shoulder before it is slid sideways. The Lehigh Valley has overcome this difficulty by devising a special rail hook which is passed under the rail to engage the base on the side from which the spikes have not been withdrawn. The other end of the hook is attached to the load line of the crane, and as it is lifted the rail is given a rolling motion which frees it from the shoulder.

For many years the Lehigh Valley has been an outstanding exponent of mechanization of maintenance operations, including the laying of rail. In this work, the fullest use is made of power machines, as well as devices, such as that just mentioned, which will ease the burden of labor and increase the productive output of its gangs.

Practices Are Not Nearing Standardization

It would be possible to cite numerous other examples and refer to other roads, but to do so would only add emphasis to the original statement that the wide variations which seem to occur in rail-laying practices are not fundamental, but superficial. What has been said also emphasizes the fact, however, that these practices are not yet nearing the point of standardization, although only the details of organization and methods are really at variance. Furthermore, it is apparent that modern rail laying requires the intensive use of power machines if the work is to be done effectively and efficiently. Despite this latter fact, and in the face of records made by those who make full use of the machines that are available to them, there are still a number of roads that are not yet convinced that full mechanization is desirable in laying rail. Yet evidence is constantly accumulating that only by the most complete and intensive use of mechanical aids can true economy be demonstrated. Despite this, however, there is now, and probably always will be, a need for substantially all of the hand tools that are required in other forms of maintenance. Obviously, this need is equally insistent when the rail is laid by hand.

One reason why these practices are not yet near standardization lies in the constant development of equipment to perform new tasks and the improvement of existing machines to adapt them more fully to the tasks they are performing. During the lull in rail-laying activities some manufacturers have been quietly designing new machines to perform classes of work for which no equipment has hitherto been available. Others have been developing more efficient machines of types that are already in service, while still others have redesigned or otherwise improved various machines already in use.

Only a few of these developments have been announced, although most of them have reached the stage where production can begin as soon as there are indications that it is possible to create a demand for them. As a result of these activities, it may be expected that in not a few instances there will be a still greater degree of mechanization in laying rail than there has been in the past and that corresponding changes in the details of practice will be made.

While it is to be expected that as much of the rail as possible, on both northern and southern roads, will be laid during the winter, the situation with respect to allied work is different in the North from that in the South. In the South, tie renewals, ballasting and surfacing can follow closely the laying of the rail. In the North, however, these operations must wait until the frost is out of the ground.

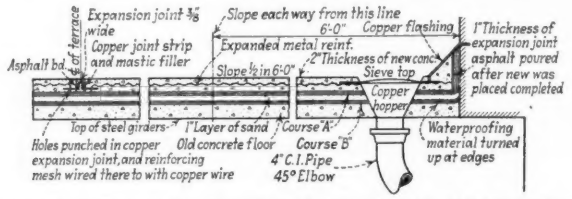
Both the laying of the rail and the incidental work in connection therewith will give employment to a large number of men. It is estimated that 9,000 men will be required for three months in laying the rail and that 20,000 men will be required for a similar period on the collateral work, while a still larger number of men will be employed in the manufacture and transportation of the raw materials and finished products.

Applying the Two-Inch, Reinforced Gunite Wearing Course

Acute Waterproofing Problem Solved

Years of difficulty ended by making the membrane layer independent of the slab and the protection course

AFTER having encountered difficulty for about 17 years with the waterproofing of a light concrete slab over a series of tracks and platforms at Ottawa, Ont., the Canadian National finally solved its problem in 1925, and the waterproofing provided then, which has now been in service for more than seven years, is still absolutely watertight, and gives promise of indefinite life. Subjected to a variation in temperature ranging from 30 to 40 deg. F. below zero in winter to over 100 deg. in summer, the original fabric and fiber asphalt-saturated waterproofing laid in the usual manner, stretched and tore, and asphalt top dressing cracked and blistered, permitting water to pass to and through the concrete slab, which had itself cracked at many places as a result of these extreme temperature changes.


Expansion joint ⅜" wide
Copper joint strip and mastic filler
Asphalt bd.
Slope each way from this line
6'-0"
Copper flashing
Expanded metal reinf.
2" Thickness of new conc.
Slope ½ in 6'-0"
Sieve top
Copper hopper
1" Thickness of expansion joint asphalt poured after new was placed completed
Top of steel girders
1" Layer of sand
Course "A"
Course "B"
Holes punched in copper expansion joint, and reinforcing mesh wired there to with copper wire
Old concrete floor
4" C.I. Pipe
45° Elbow
Waterproofing material turned up at edges

A Section Through the Tunnel Roof Slab, Showing Waterproofing and Joint Details

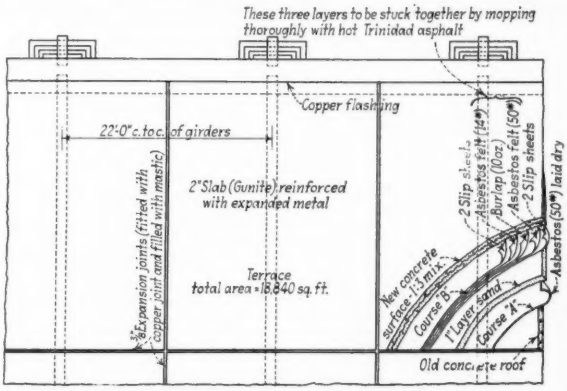
Confronted with this aggravated problem, it became evident that any waterproofing of the deck could be made effective only by keeping separate the concrete structure from the waterproofing surface. In incorporating this principle, new built-up waterproofing was laid over a 1-in. cushion of sand, and was then covered with a 2-in. layer of gunite concrete; the waterproofing course being separated from both the sand and the gunite layers by slip sheets.

Statement of Conditions

The slab or deck which gave trouble is a tunnel roof, which covers three tracks and two passenger platforms of the Canadian Pacific, directly alongside the Chateau Laurier, a hotel owned and operated by the Canadian National. This roof, which is approximately 300 ft. long by 55 ft. wide, with a parapet wall around its outer edge, is used by the hotel as a promenade and tea garden. Except for a canopy over a relatively small section near the center, the area is uncovered and subject to the direct rays of the sun in the summer, and has as much as a foot or more of ice on it throughout the winter.

The shallow deck slab, with expansion joints transversely at intervals of about 50 ft., is supported on I-beam stringers and cross girders, and is pitched slightly toward drains at the building and parapet lines. The original waterproofing was of the membrane type, with four plies laid directly on the slab and covered with a one-inch coal-tar mastic wearing course. Almost from the time of its completion, this waterproofing gave trouble. In the winter the wearing course opened up in irregular cracks at numerous points, and, although concealed, it was evident that the fabric waterproofing had been ruptured also due to expansion and contraction of the concrete structure underneath. Continual patching and filling of the cracks with Tarvia had only temporary effect in stopping leaks through the slab, leaks which were particularly objectionable when over the tunnel platform areas. In the summer the Tarvia became soft, and offered anything but a good walking surface.

This combination of circumstances led to the rewaterproofing of the deck in 1925, incorporating the feature of complete independence between the waterproofing course and the slab and the wearing course. This feature permits free expansion and contraction of both the slab and the upper course without affecting the waterproofing fabric. That this relation was effected is evidenced in the fact that whereas the new construction has now been in service for approximately eight years, no leakage through the tunnel roof has occurred.


These three layers to be stuck together by mopping thoroughly with hot Trinidad asphalt
Copper flashing
22'-0" c. to c. of girders
2" Slab (Gunite) reinforced with expanded metal
⅜" Expansion joints (filled with copper joint and filled with mastic)
Terrace total area = 18,840 sq. ft.
2 Slip sheets
Asbestos felt (44")
Burlap (10 oz.)
Asbestos felt (50")
2 Slip sheets
Asbestos (50") laid dry
New concrete surface - 1:3 mix
Course "B"
1" Layer sand
Course "A"
Old concrete roof

A Section of the Tunnel Roof in Plan, Showing Details of Waterproofing

After the old waterproofing had been completely removed from the deck, the first step in the new work was to clean thoroughly all cracks in the concrete slab, and then to fill them with asphalt mastic. Following this, strips of roll-roofing, 32 in. wide, were placed dry over all cracks.

Thus prepared, a layer of 50-lb. asbestos felt was laid dry over the entire deck, well lapped at the sides and ends of strips, and this was then covered with a layer of clean, soft, fine sand, screeded over and hand compacted to a uniform depth of one inch. Slip sheets of ordinary building paper were laid continuously over the sand, and the waterproofing course then followed.

Two Layers of Asbestos Felt

This waterproofing course consisted of a layer of 50-lb. asbestos felt, followed by a layer of 10-oz. burlap and then a layer of 14-lb. asbestos felt, these layers being turned up along the parapet and building walls and stuck together throughout by thorough moppings of hot liquid asphalt. To separate the waterproofing course from the top gunite wearing course, two slip sheets of building paper were laid over the top layer of asbestos felt.

The wearing course consisted of a two-inch layer of gunite concrete, reinforced through the center with a layer of two-way, electric-welded reinforcing mesh. To provide for expansion in the wearing course, it was divided by expansion joints into sections 27½ ft. by 22 ft. The expansion joints were made ⅜ in. wide and

A General View of the Chateau Terrace, Showing the Various Stages of Waterproofing Under Way

were provided with a copper expansion strip embedded deeply in the gunite on both sides. The openings at the joints were filled with asphalt mastic.

To insure positive action of the expansion strips with the expansion and contraction of the gunite sections, the strips were wired to the reinforcing mesh through holes punched in their flanges. Copper flashing was provided entirely around the roof areas, well embedded in both the gunite slab and the walls.

The gunite used in the top, or wearing course consisted of one part of cement and three parts of sand, and was placed in the usual manner with a cement gun. In this work the full depth of the course was shot at one time, and as soon as completed, the surface was trowelled off to a smooth final finish.

One Mistake Made by the Field Forces

Leakage through the tunnel roof was completely stopped by construction employed. At the present time the gunite wearing course is in sound condition and there is no indication anywhere that the waterproofing layer is not in as good condition as when laid. However, on some of the sections of gunite wearing surface, cracks appear. An examination of these cracks shows that they only penetrate about half an inch. These cracks are due to the fact that, in spite of specifications requiring that the gunite slab be shot to the full thickness in one operation and trowelled to a sidewalk finish, the difficulty of getting a sufficient number of concrete finishers to keep abreast of the guniting, and the desire to advance the work as rapidly as possible, led to a de-

Laying the Waterproofing Course Over the One-Inch Layer of Sand

cision in the field to permit the gunite to be placed in two courses: the first course being applied to a depth of a half-inch above the reinforcement and then permitted to harden before the application of the finishing coat was attempted.

Plane of Weakness Is Set Up

This set up a plane of weakness through the gunite above the reinforcing mesh, which has permitted the thin top layer to crack and break away from the thicker bottom layer at several places. At some of these places water gets beneath the top layer and, in wet weather, oozes out when the top layer is stepped upon, but in no case is there leakage through the tunnel roof, indicating that the waterproofing fabric is still intact and also, that, in all probability, the lower, reinforced section of the gunite slab has not been affected. Where the gunite slab was shot to its full thickness in one continuous operation, in accordance with specifications, it is still perfectly sound.

The successful waterproofing of the deck was designed in the bridge department of the Central region of the Canadian National, at Toronto, under the direction of C. P. Disney, bridge engineer, T. T. Irving, chief engineer and W. A. Kingsland, general manager. The work was done by company forces.

Winter Brings Greater Problems to the Maintenance Forces

Railroads Urged to Buy Rails

Government creates organization to handle loans—Carriers authorized to place orders with the mills direct

EVERY effort is being made in Washington to expedite the purchase of rails at the reduced price agreed upon with the manufacturers, as announced in last month's issue. On November 2 the special Board of Public Works of the Public Works Administration formally allotted a maximum of $51,000,000 for loans to the railways in financing the purchase of rails and track fastenings, and on November 7, Harold L. Ickes, secretary of the interior and administrator of public works, announced the appointment of Frank C. Wright, vice-president of the Bangor & Aroostook, as chief of the transportation loan division to administer the detailed work of making the loans.

The first application for a loan, submitted to the Interstate Commerce Commission for the purchase of rails, was that of the Chicago, Milwaukee, St. Paul & Pacific, made public by the commission on November 8. This road asked authority to issue $1,818,750 of 10-year promissory notes, without interest for the first year and bearing 4 per cent interest thereafter, to the United States Government, for the purchase of 50,000 tons of rails. This road also expects to make an application for another loan to cover the cost of fastenings to go with the rail, after the price for fastenings has been determined. Applications for loans have since been made by the Chicago & North Western to cover the purchase of 65,000 tons of rail and 18,000 tons of fastenings, and by the Chicago & Eastern Illinois to cover the purchase of 4,000 tons of rail and the necessary fastenings, while numerous others are expected in the very near future.

Revised Figures Being Compiled

In the meantime Co-ordinator Joseph B. Eastman has been receiving revised figures from the railroads as to the quantities of rail and fastenings that they will take, now that the rail price has been determined, but they are still somewhat tentative. It is understood that there may be considerable differences between the final figures and the tentative commitments listed in the November issue, because some of the latter were contingent upon a price of $35 a ton, whereas $36.375 has since been fixed as the base price, and also because there has been some change in business conditions since the matter was first discussed.

Several railroads, following the action taken by the Pennsylvania, in October, have proceeded to place their own orders for rails without the aid of government loans. In addition to the orders for 100,000 tons placed by the Pennsylvania, the Norfolk & Western has purchased 10,000 tons of rail, while the Chicago, Burlington & Quincy has ordered 25,000 tons of rail and 8,000 tons of fastenings. The financing of rail purchases by several roads themselves was not unexpected, as Mr. Eastman's letter to the steel companies stated that with respect to 452,785 tons, and perhaps 502,785 tons, out of the total of 844,525 tons then proposed to be purchased, the orders were contingent upon loans from the P. W. A. However, the allotment was made in a round sum to show the administration's good intentions.

Must Be Approved by I.C.C.

According to an announcement by the P. W. A., all loans to the railways are subject to the approval of the Interstate Commerce Commission and the execution of contracts, satisfactory to the administrator, between the government and the several railroad companies. "Negotiations for these contracts have been advanced during the past few days," the announcement states, "and the allotments were made to expedite the work and establish the good faith of the Administration in making the money available." Negotiations have since been in progress but many questions have arisen as to the application of the labor restrictions in the recovery act and, in some instances, as to the security to be furnished by the railroad companies, and the administration has announced a policy of not announcing the names of the individual roads with which negotiations have been conducted, "until the present progress results in definite allotments."

Section 206 of the national industrial recovery act provides that all contracts let for construction projects and all loans and grants pursuant to the law shall contain such provisions as are necessary to insure that, "so far as practicable and feasible," no individual directly employed on any such project shall be permitted to work more than 30 hours in any one week. A general interpretation had been made that this restriction would not apply to work done by the railroads with their own forces but that as to contracts let by the railroads the N. R. A. code provisions as to labor conditions should govern. In many instances the codes for manufacturers supplying railway materials and equipment have not yet been put into effect. There is also a provision that the maximum of human labor shall be used in lieu of machinery, "wherever practicable and consistent with sound economy and public advantage."

Simplify Purchasing Procedure

While these requirements for the execution of loans have had the effect of impeding progress and given rise to some reluctance on the part of the railways to apply for loans, recent action by the office of the co-ordinator in simplifying the purchasing procedure will undoubtedly speed up the ordering and delivery of rail. Whereas

the original plan provided for the consolidation of the requirements of the participating railroads and the allotment of group orders to the mills, it has now been decided to allow the roads to divide their orders among the steel companies as they deem proper, on condition that the rail be bought at the cheapest place from the standpoint of cost at the point of use. Instead of asking prices for the fastenings on behalf of the roads as a whole, as he did in the case of the rails, Mr. Eastman has also authorized the roads to ask prices on their own account and it is understood they will place their own orders, although they are advising him as to the prices quoted, through the American Iron and Steel Institute.

That the government is anxious to have the railroads borrow money to "get things started" is evident from the plan "for the purpose of better enabling railroads to employ additional men and make extra purchases of supplies during the winter and succeeding months" as announced by the board of directors of the Reconstruction Finance Corporation on November 13, when it reduced the interest rate on loans to railroads, including both new loans and existing loans which amounted to about $330,000,000, from 5 per cent to 4 per cent per annum on condition that the railroads use the saving, with substantial additional amounts, for expenditure in relief employment. An abstract of the announcement by Jesse H. Jones, chairman of the corporation, follows:

This action is based upon requests for a reduction in interest rates from a number of railroad executives who have offered to use the amount of such reduction, together with substantial additional funds, in making extraordinary expenditures during the next six months. This would mean expenditures for labor, equipment and material over and above their budgets for this period, or in excess of the program presently contemplated by them, the purpose being to help to promote the President's recovery program. In the light of these representations, and in order to afford the railroads an opportunity to render this additional assistance, the board felt justified in granting this temporary interest reduction.

The Directors of the RFC have taken this action with the expectation that the savings in interest will be availed of and used by the railroads in the spirit herein outlined, together with very substantial additional amounts to be otherwise provided and expended by the railroads in relief employment.

Administrator Ickes Announces Policy

The Public Works Administration, however, will henceforth, constitute the primary agency for the extension of federal loans to the railways, its policy being definitely indicated in a statement issued by Administrator Ickes which was in part as follows:

PWA wishes to expedite this work so that railroads, which are among the country's greatest employers, will be able to finance such purchases with reasonable interest and in this way recall a great number of men to jobs in the fabrication of steel rails and other equipment and to aid the heavy industries in furthering re-employment in the large centers of unemployment.

Therefore, it was declared the policy of PWA to buy qualified securities of railroads desiring to purchase equipment now. This money almost entirely will go into pay envelopes of the various industries involved and add to purchasing power in the mine districts, factories, steel mills and shops as well as to railroad pay rolls.

Money will be advanced from month to month as may be necessary to finance the purchase by the railroads of equipment. Interest will not be collected for the first year as the administration seeks to encourage such railroad purchases and not embarrass the carriers at this time by further immediate commitments. After the first year the interest will be at the rate of four per cent.

While in the past few days marked progress has been made in reaching terms with the carriers, all details have not yet been settled. Allotments, however, are proper at this time and these details will be cleared before contracts are made which must be satisfactory to the administration.

At the same time that the allotment was made for rails, the board also allotted $84,000,000 for a loan to the Pennsylvania for the completion of its electrification project between New York and Washington, for related improvements and for the construction of freight and passenger cars, and announced a policy of making loans for the purchase of equipment. Later it called attention to the possibilities of bringing about a great deal of employment by making loans to the railroads for repairs to cars and locomotives.

Explains Mr. Wright's Duties

Administrator Ickes also issued a statement concerning the appointment of Mr. Wright as chief of the Transportation Loan division, calling attention to his service as assistant director of the Division of Operation of the United States Railroad Administration from 1918 to 1920. "The PWA has planned to set up a division to carry on this work," the announcement stated, but awaited Mr. Wright's acceptance of the appointment before organizing. Mr. Wright brings to PWA a long experience in transportation work, having served with several railroads.

"The Transportation Loan Division of PWA will advise the administrator in the exercise of the clause of the Public Works Act which empowers the Administration's aid in the financing of such railroad maintenance and equipment as may be approved by the Interstate Commerce Commission as desirable for the improvement of transportation facilities."

Since his appointment Mr. Wright has been in active contact with representatives of the railroads, and on November 20 the administration released a statement saying that he had reported to Administrator Ickes that "negotiations necessary to clearing away details and closing these loans are moving forward rapidly." "In the meantime," it was stated, "plans are being perfected by the borrowing roads, steel companies, and other material manufacturers for getting men back to work immediately." This statement also emphasized the possibilities of creating additional employment by making loans for repairing locomotives and freight cars that have long been out of commission and awaiting repairs. Coordinator Eastman's organization has been making a survey of equipment condition on the various roads. Col. H. M. Waite, deputy administrator of public works and himself a railroad engineer of long experience, has also shown a great interest in the railroad loans and has participated actively in the discussions.

Instructions for Applying for Loans

On November 25, the Public Works Administration issued Circular No. 5, which gives detailed instructions to be followed by the railways in setting up the information that must accompany an application for aid in financing railway maintenance work, equipment purchases and other projects. Typical of the data required are such facts as are called for in the following excerpts from the bulletin.

A description of the work should be given, showing the work to be done and/or the equipment to be acquired, built, or repaired, with the estimated cost of labor, materials, and other items of expense which will be required to complete the same. Such estimates should be set up in accordance with the classification of accounts prescribed by the Interstate Commerce Commission. Description should show the types of work to be done and the number of men to be employed in each type of work and the length of their respective employments.

A statement should be given as to all contracts prepared or entered into or to be prepared and entered into in relation to the work to be financed, the parties to such contracts, and the terms thereof, together with a statement of the work necessary to complete all contracts made prior to the filing of the application and the estimated cost of labor and materials which will be required to complete all such prior contracts.

Solving the Safety Problem on the Louisville & Nashville*

Road adopts a comprehensive program of education and instruction which involves the activities of all grades of employees

By G. C. WENDLING

Division Engineer, Louisville & Nashville, Paris, Tenn.

ALTHOUGH a safety movement was started on the L. & N. in 1918, it was not prosecuted and supported actively and, as a consequence, the number of injuries among employees of the track department continued to increase gradually until the beginning of 1927. Early in that year, following a reorganization of the track department, attention was directed to the fact that 25 per cent of the total injuries were occurring among employees of this department, whereas those employees were working less than 20 per cent of the total man-hours.

During the balance of that year we worked diligently to improve our safety showing and by the end of the year managed to show a reduction of 12.7 per cent in the number of injuries in the track department, as compared with the previous year. Year by year we have continued to reduce injuries, so that by 1932 injuries in the track department showed a reduction of 92 per cent, as compared with 1926. Furthermore, the proportion of the total injuries chargeable to this department declined from approximately 27 per cent in 1926 to 15 per cent in 1932.

Foremen's Interest the Keynote

The keynote of our endeavors has been the development of an interest in the safety situation among the foremen, and our experience indicates that we have not erred in this respect. If the foreman develops the safety habit the safety of his crew is assured. The foreman will acquire the habit of safety if he is held strictly accountable for the actions of his men, and is given the proper training by means of pertinent printed matter, by instructions, and by the example of his supervisor, his roadmaster, his division engineer and his superintendent. Without moral support from these officers, all the printed matter that can be sent him will avail nothing, for he will not take a vital interest in the matter. Our first necessity, therefore, was to enlist the interest and co-operation of these officers in the safety movement.

Realizing that the division officers are influenced exactly as are the foremen, namely, that they reflect the attitude of the men above them, we went to the top, the president, and secured from him a statement which served as the keystone for the building of our safety organization, in all other departments as well as in the track department. His statement, in part, read as follows:

> Safety First means that safety comes before everything else, and this must be our guiding principle in the future.

This statement provided us with a fulcrum, the lever being supplied by the general manager in the form of a statement similar to that of the president, in the closing portion of which he said:

> I wish to bespeak the hearty and mutual co-operation of each individual employee, their mothers, fathers, wives, daughters and sons in this great work, primarily designed to promote the health, comfort and happiness of all directly and indirectly concerned.

Safety Divided into Two Parts

With the guidance of experts from our safety department we of the track department first proceeded to analyze the personal injury situation as it applied to this department. The result of this analysis was the conclusion that in this department, at least, safety work should be divided into two classes—primary safety and secondary safety. Under the heading of primary safety came the general policies designed to affect the masses of our workers, such as the development of the proper morale, the inculcating in the men of the desire to improve their records and the development of a spirit of interest and of competition between the various units.

Under the heading of secondary safety were classified the actual preventive measures to be taken on the ground, including supervision, the reporting of injuries, the instructing of the men as to the safe way in which to perform their various duties, the supervision of tools and the inspection of equipment. In other words, under this heading were classified measures having to do with the removal of the causes of injuries.

While the various activities were classified in our minds as between primary and secondary, in actual practice they were graded in no such a descending scale; every act and every movement was given equal importance and this thought was carried to the men through personal contact. During trips over their territories, the division engineers, roadmasters and supervisors, as well as the other officers of the company, both division and system, addressed the men in the gangs, even interviewing them individually. They asked questions and if the answers were not known, saw that the men were properly instructed. They also made inspections of tools and equipment. All this led to a deep-seated realization by the men that they were being observed and that safety was not only a matter for preaching but for practicing.

Book of Rules

One of the first moves in the safety campaign was the preparation of a book of safety rules, in which were incorporated rules based on reports of injuries that had occurred in the past. The foremen were instructed to pattern their daily lives after these rules; to learn the rules and teach them to their men; to discuss the rules with their men during the noon hour; to remind the men before starting out every morning of the necessity for working safely through the day; to go over with their men the precautions that should be taken in performing special work; to point out to their men the violations that caused specific injuries; and to impress the men

*An abstract of a paper presented before a joint meeting of the Safety section, American Railway Association and the Steam Railroad section of the National Safety Council during the twenty-second annual Safety Congress and Exposition at Chicago.

with the fact that the rules were made primarily for their protection. The foremen were also asked to impress their men with the fact that to work safely does not mean to work slowly, our experience having proved that the reverse is true. In fact we have found that the more closely the actions of the men conform to the safety rules, the more efficient their work becomes. Working safely does not mean decreased efficiency. These rules and instructions are supplemented by educational material.

Discipline Applied

After the broader policies of the work were outlined and well in hand our attention was turned to the details of the work and here we found much to be accomplished. The men were in the habit of using tools that were not in proper condition, a practice which resulted in a large number of injuries. While these were usually of a minor nature, we have always looked upon them as being equally as important as serious injuries, feeling that they are only minor injuries by chance and that the hazard should dictate our actions and not the fact that a scratch happens not to be a cut, or a sprained ankle not a broken one. Among other things, the men would persist in jumping rails, in working too close together, in standing too near passing trains, and in throwing things without looking to see that no one was in the way, all of which were the result of the lack of interest on the part of the men and of adequate supervision on the part of the foreman. On these matters we are still working.

We find it difficult in some cases to convince our men, even some of the foremen, of our seriousness in this matter of safety. In some cases we have been forced to resort to discipline and, in my opinion, such cases are helping us greatly in making progress in our campaign of education and enforcement. The day of the heavy hand is past, but the day of right is still with us, and it is certainly the right of an employer, after he has provided his employees with proper equipment and safe conditions under which to work, to insist that his men perform their work in a proper and safe manner.

Many railway men are of the opinion that discipline will not stop accidents and that education is the only remedy. However, we maintain that the example of applied discipline is of greater educational value and has more force than a long series of appeals, arguments or instructions. There are several reasons why men are not willing to observe safety rules. In some cases they are not convinced of the necessity for a rule and in these cases they must be forced to bow to the superior experience of those above them. Sometimes they think they can violate a rule and get by without an accident and in these cases they must be taught that they will not be allowed to take chances. In some cases they flagrantly disregard a rule through bravado, indifference or ignorance, in which cases they must be shown again that such actions are being watched for by their superiors. In all these cases the application of just discipline will be found of more real value than any method yet developed.

In any program for reducing personal injuries, the importance of using as much care as possible in the selection of laborers should be emphasized. A considerable proportion of the men who apply for work are in such a diseased condition that even ordinary service may cause a recurrence of their troubles. Their condition may also have a direct bearing on the healing of any injuries which may be incurred.

The safe operation of motor cars has proved to be a difficult problem, as this relatively new means of increasing the efficiency of track forces has not been without its abuses. Excessive speed was often indulged in and the movements of motor cars were not properly protected,

On the Kentucky Division of the L. & N.—Extra Precautions Are Necessary to Avoid Accidents in Territories Containing Tunnels

with the result that there were collisions with trains and with other motor cars, as well as with automobiles at road crossings. Movements at night and through tunnels were not given proper protection, and as a result there was a succession of accidents which was very discouraging. All such accidents have been fully investigated and we have undertaken to apply the proper remedy as well as to administer discipline where we have felt that it was warranted.

One of the most important rules is as follows:

Approach street or road crossing, station platforms or persons or animals near the track *under full control.* Be prepared to stop, if necessary.

This rule has been reinforced by special instructions requiring cars to stop where the view is not sufficient. We have long required motor cars to be operated at not to exceed 20 miles per hour and in such a manner as to permit stopping them within half the range of vision. Accidents occurring in connection with the operation of trailers are also very important and an effort is being made not only to have the trailer cars themselves carefully inspected but the means of coupling them to the motor car and the manner in which the trailers are loaded given constant attention.

Causes of Injuries Analyzed

A detailed analysis of the injuries occurring in the track department of the L. & N. during a typical period showed that while they were divided among 18 causes, more than 50 per cent of the total were chargeable to the handling of rail and ties, of which group 65 per cent were incurred in handling rail and 35 per cent in handling ties. This was to be expected since ties and rails are the heaviest materials handled by track forces.

One of the most important steps to be taken for the purpose of improving this condition was to arrange for new rail to be loaded on flat cars instead of in gondolas. This arrangement alone removed one of the most fruitful sources of accidents in the handling of rail.

A careful study of the situation on the ground revealed that lack of supervision was responsible for a large portion of the injuries occurring during the handling of rail and we are now insisting that supervision be given to all matters pertaining to the handling of

rail and that all movements be made according to signals. The same principles are being applied to the loading, unloading, carrying and piling of crossties.

The next largest group of accidents, according to our analysis, occurred in connection with the operation of motor cars. Next in rank were those in which men were struck by flying objects, generally by pieces of steel from tools or by pieces of ballast while tamping ties. We are attempting to eliminate such accidents by insisting on the use of good tools, the proper spacing of men and the education of the men in the proper ways to protect themselves.

Accidents occurring under the classification "Struck by Engines or Cars," were next in importance, according to our analysis, and while this cause ranks fourth in the number of injuries, it ranks first in the number of fatalities. In fact, with few exceptions, this is the cause of all fatal injuries in our department. Some of our divisions are double tracked and on these divisions naturally the greatest difficulty is experienced in getting the men to keep properly in the clear of trains. Either the foreman should be with his men at all times and should act as a lookout or he should appoint some member of the crew to perform this function when he leaves the gang. Men must be taught that they must clear all tracks promptly and properly on the signalled approach of a train and that no conditions must be permitted that will prevent the men from hearing the signalled or actual approach of a train. This consideration is becoming more important as the railroads increase the number of rail welders in their service and add such equipment as tie tampers and devices that are operated by gasoline engines, all of which produce such noise that the approach of a train might easily be overlooked.

Falls due to slipping or tripping, bruises and lacerations, self-inflicted injuries, strains caused by lifting, blows struck by tools in the hands of others or by falling objects, and falls are all common causes of injuries in our department. In practically all cases, such injuries are a result of the violation of one safety rule or another, and will be eliminated only when a high regard for the rules and an appreciation of the fact that safety is a personal issue are planted in the minds of the men.

String Lining Curves Without Stakes

THE method of string lining curves that was described serially by Charles H. Bartlett in *Railway Engineering and Maintenance* for January to July, 1928, inclusive, has considerably lessened the labor of those responsible for the field work of lining curves and has earned the respect of those who have used it because of the practical results obtained. However, in spite of the considerable saving in time that this method gives as compared with the transit method, much time is still consumed in staking out curves, especially in stone ballast. To eliminate the time required to drive stakes, an eastern railroad has devised a method of lining curves without the aid of stakes which permits most curves to be measured, the throws figured according to the Bartlett method, and the lining of the curves completed in less time than would otherwise be required.

In this method, a string takes the place of the stake as the point from which the curve is lined. If the ends of a string are held at the joints on each side of the one to be thrown, any throw at that joint will not change the position of the string. The string therefore serves the same purpose as the stake in providing a fixed point from which to measure the throw of the track. To line any joint the calculated amount, it is necessary only to measure the existing mid-ordinate, add or subtract the amount of the throw, depending on whether it is out or in, and line the track accordingly.

In Fig. 1, let DEF represent the original curve and D′E′F′ the relined curve, with ME as the original ordinate at E. Assuming that the track has been lined

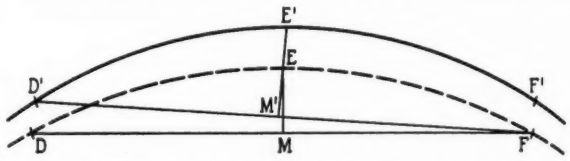


Fig. 1—Diagram Showing the Application of the Method

from the left through point D (now D′), the existing ordinate is therefore M′E. By measuring the ordinate M′E, and adding the previously calculated throw EE′, the proper amount of throw as measured from the string is obtained.

Two Measuring Rules Used

When measuring the throw from the string, it is suggested that two measuring rules be used, one laid flat on the top of the other as shown in Fig. 2. By placing the end of the top rule at the string and the end of the bottom rule against the gage side of the high rail and holding them firmly together as the track is lined, the proper throw can be read directly on the

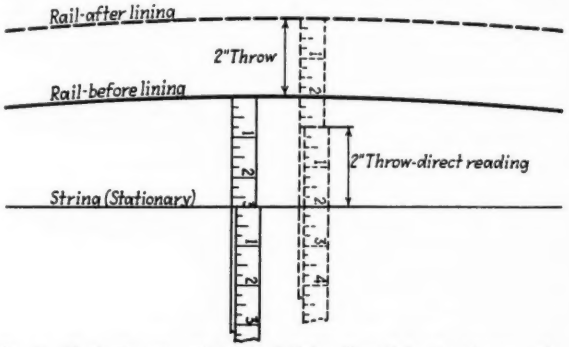


Fig. 2—Illustrating the Method of Using Two Rules to Measure the Throw From the String

top rule. When lining the track inward, the direction of the rules is reversed and the end of the bottom rule is held against the outside of the high rail.

Where the throws are excessive, requiring additional ballast, the widening of the roadbed, the shifting of turnouts or short span bridges, or a review by supervisors on the ground before the work is done, it is, of course, advisable to use stakes for lining the curve. However, the method just described has been found to be applicable to the majority of curves. It is reported to be especially valuable when "smoothing up" curves or parts of curves, as it allows the supervisor to work on a curve with his foreman, often between trains, without waiting for stakes to be driven. Moreover, it is pointed out that the foreman who understands the string lining method can keep his curves lined at more frequent intervals with less inconvenience by using this method than with stakes.

Simplifying Vertical Curve Calculations*

Through the use of simple formulas and a table of constants this once tedious task is reduced to a mechanical process easy of application

By H. L. SMYTHE
Engineering Advisory Committee, Van Sweringen Lines, Cleveland, Ohio

THE methods employed in calculating vertical curves on railroads are generally considered to be about as efficient as can be derived from the simple formula on which these curves are based and, as a consequence, no concerted effort has been made to find a more convenient means of securing the desired results. The writer, however, in casting about for a suitable vertical curve solution that would be simple and capable of application by those not having a complete knowledge of the underlying principles, has devised a table of coefficients by which the offset from the tangent to the vertical curve at any point on the curve and for any rate of change of grade per station can be readily determined.

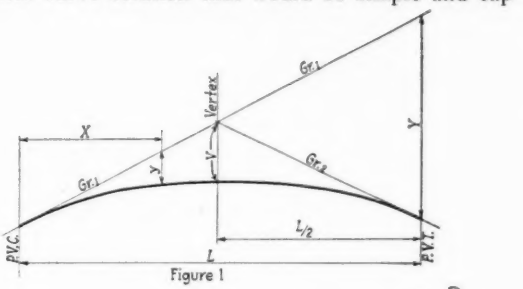


Figure 1

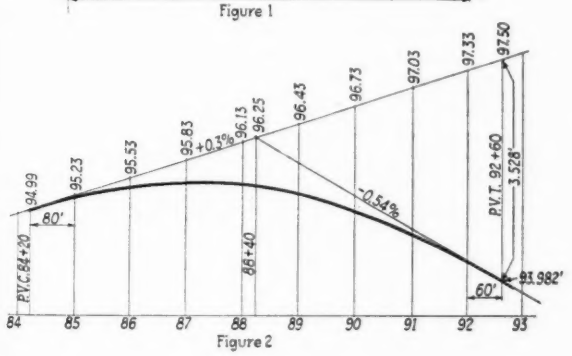


Figure 2

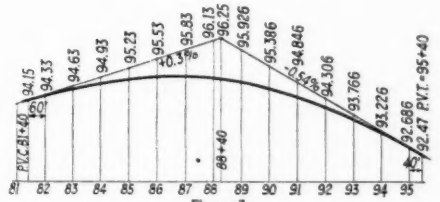


Figure 3

Diagrams Illustrating the Principles Involved

The offset method of calculating vertical curves, based on the parabolic curve, is in general use by the railroads today, and the application of this method is simple enough when the curve begins and ends at even main line stations. However, with a fixed rate of change of grade per station, as now adopted by most railroads, and with intersecting grades differing by odd hundredths of a foot, vertical curves with lengths in odd figures occur frequently, thus necessitating the calculation of offsets at the first two and at the last main-line stations on the curve, in order to determine the rate of grade of the chord between the first and second stations and to check the computations at the end of the curve. Moreover, bridge abutments and piers, as well as critical points on grade separation structures rarely occur at even stations and a rapid method of calculating the offsets at such points is highly desirable.

Before undertaking a discussion of the table and an explanation of its use with the aid of examples, it may be well to review some of the formulas and terms used in connection with the calculation of vertical curves. In Fig. 1 are shown the letters and terms that are used to denote the various dimensions and parts of vertical curves. A further explanation of this terminology, in which the symbols have been selected so as not to conflict with those used to represent functions of plain or spiral curves, is given below.

P. V. C. = Point of vertical curve
P. V. T. = Point of vertical tangent
Vertex = Point of intersection of grades
L = Length of vertical curve in 100-ft. stations
H = Algebraic difference of intersecting grades
K = Rate of change of grade per 100-ft. station on vertical curve
V = Offset from vertex to vertical curve in feet
Y = Offset from tangent to end of vertical curve in feet
y = Offset from tangent to vertical curve at any point in feet
x = Distance to any point on vertical curve in 100-ft. stations
Gr_1 and Gr_2 are the intersecting grades

Employing the basic formula for a parabolic curve and using the foregoing terms the following formula can be derived.

$$L=\frac{Gr_1-Gr_2}{K}=\frac{H}{K} \text{ where } H=Gr_1-Gr_2$$

$$K=\frac{H}{L}$$

$$Y=H\frac{L}{2}$$

$$y=X^2\frac{K}{2}$$

$$V=\frac{Y}{4}$$

If all symbols for one vertical curve are characterized by the figure Sub 1 and for a second vertical curve by the figure Sub 2 and if H is the same for both curves,

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then the following ratios between the two curves can be derived from the above formulas.

$$\frac{L_2}{L_1}=\frac{V_2}{V_1} \qquad \frac{V_2}{V_1}=\frac{K_1}{K_2} \qquad \frac{K_1}{K_2}=\frac{L_2}{L_1}$$

From these ratios it is seen that the offset at the vertex varies directly as the length of the curve, that the rate of change of grade per station varies inversely as the offset at the vertex, and that the length of curve varies inversely as the rate of change of grade. In an example given later it will be shown how these ratios may be used to select vertical curves so that excessive cuts at sags and fills at summits will be eliminated.

Table I gives the offsets from the tangent at each 10 ft. (or 0.10 of a 100-ft. station) measured from the point of tangent to Station 12, for a vertical curve having a rate of change of grade of 0.10 per cent. As shown by one of the foregoing formulas, offsets for any given distance from zero are directly proportional to the rate of change of grade, and for any point on a curve the offset may be found by use of the equation $y=\frac{y^*K}{0.10}$, where y is the offset desired, y* is the offset given in the table for the distance in question, and K is the rate of change of grade of the curve under calculation. Using this equation the offsets from the tangent for any vertical curve may be obtained quickly and easily by applying the proper proportions to the values in the table. Offsets for intermediate points can be obtained by interpolating between the values in the table, although between stations zero and eight the use of "plus" values to the nearest foot will give sufficiently accurate results. When interpolating it will be helpful to remember certain relationships that exist between the offsets and which are demonstrated in the following paragraphs.

Table I

Offsets to the tangent of the vertical curve at each one tenth of a station from the point of tangency (Station 0+00) to Station 12, for a rate of change of grade of 0.10 per cent per station. The offset at any station for any other rate of change of grade bears the same relation to the offset given in the table for that station as the relation of the given rate of change of grade to the rate of 0.10 per cent per station.

Rate Of Change Of Grade = 0.10%

Station	Offset	Station	Offset	Station	Offset	Station	Offset
0+00	0.0000	3+00	0.4500	6+00	1.8000	9+00	4.0500
+10	0.0005	+10	0.4805	+10	1.8605	+10	4.1405
+20	0.0020	+20	0.5120	+20	1.9220	+20	4.2320
+30	0.0045	+30	0.5445	+30	1.9845	+30	4.3245
+40	0.0080	+40	0.5780	+40	2.0480	+40	4.4180
+50	0.0125	+50	0.6125	+50	2.1125	+50	4.5125
+60	0.0180	+60	0.6480	+60	2.1780	+60	4.6080
+70	0.0245	+70	0.6845	+70	2.2445	+70	4.7045
+80	0.0320	+80	0.7220	+80	2.3120	+80	4.8020
+90	0.0405	+90	0.7605	+90	2.3805	+90	4.9005
1+00	0.0500	4+00	0.8000	7+00	2.4500	10+00	5.0000
+10	0.0605	+10	0.8405	+10	2.5205	+10	5.1005
+20	0.0720	+20	0.8820	+20	2.5920	+20	5.2020
+30	0.0845	+30	0.9245	+30	2.6645	+30	5.3045
+40	0.0980	+40	0.9680	+40	2.7380	+40	5.4080
+50	0.1125	+50	1.0125	+50	2.8125	+50	5.5125
+60	0.1280	+60	1.0580	+60	2.8880	+60	5.6180
+70	0.1445	+70	1.1045	+70	2.9645	+70	5.7245
+80	0.1620	+80	1.1520	+80	3.0420	+80	5.8320
+90	0.1805	+90	1.2005	+90	3.1205	+90	5.9405
2+00	0.2000	5+00	1.2500	8+00	3.2000	11+00	6.0500
+10	0.2205	+10	1.3005	+10	3.2805	+10	6.1605
+20	0.2420	+20	1.3520	+20	3.3620	+20	6.2720
+30	0.2645	+30	1.4045	+30	3.4445	+30	6.3845
+40	0.2880	+40	1.4580	+40	3.5280	+40	6.4980
+50	0.3125	+50	1.5125	+50	3.6125	+50	6.6125
+60	0.3380	+60	1.5680	+60	3.6980	+60	6.7280
+70	0.3645	+70	1.6245	+70	3.7845	+70	6.8445
+80	0.3920	+80	1.6820	+80	3.8720	+80	6.9620
+90	0.4205	+90	1.7405	+90	3.9605	+90	7.0805
3+00	0.4500	6+00	1.8000	9+00	4.0500	12+00	7.2000

Relationships of Values in Table I

From Table I, the offset at Station 0+40 is 0.0080, at Station 1+40 the offset is 0 0980, or 0.0900 more, and at Station 2+40 the offset is 2.2880, or 0.1900 more. Thus, it is seen that each additional 100-ft. station has an offset in which the difference from the offset at the preceding station has increased by the rate of change of grade per station, and this is true for any series of "pluses" differing by 100 ft. or for any rate of change of grade.

It is also important to note that the difference between the offsets of any two consecutive pluses differing by 10 ft. is equal to the first station number divided by 100 with the figure 5 added to the fourth decimal place. For example, at Station 2+30 the offset is 0.2645 and at Station 2+40 the offset is 0.2880, a difference of $\frac{2.30}{100}+0.0005$, or 0.0235. With this relationship in mind, differences in the offsets between pluses differing by 10 ft. can be read from the table by inspection of their location, making the interpolation for intermediate offsets more simple by eliminating the necessity of subtracting one offset from the next one.

Example of Application

In order to demonstrate the application of this method, Figure II is used as an example. In this case the vertex of the curve is taken at a "plus" station for the purpose of making the problem as awkward as possible. It is proposed to calculate the offsets and elevations for a curve having a rate of change of grade, K, of 0.10 per cent. Using the values given in Figure II, the length of the curve, L, is found to be 8.4 stations and the value of Y is found to be 3.528 ft.

The manner in which the offsets and elevations for this curve were obtained and checked is demonstrated in Table II. It will be observed that after the offsets at Stations 85 and 86 have been obtained from Table I and set down opposite these stations in column 3 of Table II, and the difference between them placed in column 4, the subsequent difference in column 4 increases successively by the rate of change of grade, K, and this is true for any value of K. These differences are then added to the preceding offset so that each offset, including the final offset at Station 92, is obtained from its predecessor. The offset at Station 92 is then checked against the offset in the table at that distance and a correct result is a check on all the preceding offsets. As a further check on the calculations, the offset for 60 ft. of curve, which from Table I is found to be 0.018 ft. is added to the elevation of the curve at Station 92, which is 94.29 ft. to give a total of 94.308 ft., this being the elevation of the tangent at Station 92. From this figure is subtracted the drop for 60 ft. of a 0.54 per cent grade, or 0 324 ft., the result being 93.984 ft., which checks with the elevation of the P. V. T. as shown in Figure II.

Column 6 of Table II is a check on the elevations in column 5. The difference between consecutive figures in the former column, which in turn are obtained

Table II

1	2	3	4	5	6
Station	Elevation on Tangent	Offsets	Difference Between Offsets	Elevation on Curve	Check on Rate Diff.
P.V.C.= 84+20	94.99	0		94.99	
85	95.23	.032		95.20	
			+0.13		+0.17
86	95.53	.162		95.37	
			+0.23		+0.07
87	95.83	.392		95.44	
			+0.33		−0.03
88	96.13	.722		95.41	
			+0.43		−0.13
89	96.43	1.152		95.28	
			+0.53		−0.23
90	96.73	1.682		95.05	
			+0.63		−0.33
91	97.03	2.312		94.72	
			+0.73		−0.43
92	97.33	3.042		94.29	
P.V.T.= 92+60	93.98			93.98	

by taking the difference between successive elevations in column 5, should be equal to the change in rate of grade, K, or 0.10 per cent in this instance.

This method of using Table I is of the greatest benefit where interpolation is necessary to obtain the offsets, as it is only necessary to interpolate for the first two main line stations on the vertical curve, after which the offsets are obtained by increasing the difference be-

Table III

1	2	3	4	5	6
Station	Elevation on Tangent	Offsets	Diff. between Offsets	Elev. on Curve	Check on Rate Diff.
PVC= 81+40	94.150				
82	94.330	at 60 ft.=0.018x0.6= 0.011	+0.066	94.319	+0.234
83	94.630	at 160 ft.=0.128x0.6= 0.077	+0.126	94.553	+0.174
84	94.930	0.303	+0.186	94.727	+0.114
85	95.230	0.389	+0.246	94.841	+0.054
86	95.530	0.635	+0.306	94.895	−0.006
87	95.830	0.941	+0.366	94.889	−0.066
88	96.130	at 860 ft.=2.178x0.6= 1.307		94.823	−0.126
89	95.926	at 640 ft.=3.048x0.6= 1.829	+0.354	94.697	−0.186
90	95.386	0.875	+0.294	94.511	−0.246
91	94.846	0.581	+0.234	94.265	−0.306
92	94.306	0.347	+0.174	93.959	−0.366
93	93.766	0.173	+0.114	93.593	−0.426
94	93.226	at 140 ft.=0.098x0.6= 0.059 ft.	+0.054	93.167	−0.486
95	92.686	at 40 ft.=0.008x0.6= 0.005 ft.		92.681	
PVT= 95+40	92.470				

tween consecutive offsets by the rate, K, finally interpolating for the last station and making the check.

A variation of the problem is demonstrated in the following example in which is shown the operation of the method when the value of K is other than 0.10 per cent and when the curve is more than 12 stations long. In this example, see Figure III, the situation is the

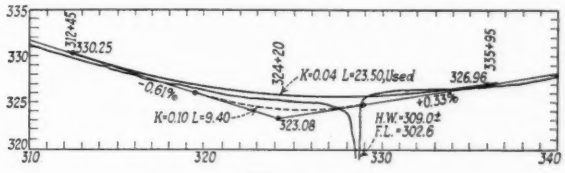

Figure 4

same as in the previous example except that K is reduced to 0.06 per cent. Using this value of K, L becomes 14 stations with the P. V. C. at Station 81+40 with an elevation of 94.150 ft. and with the P. V. T. at Station 95+40 with an elevation of 92.470 ft.

In Table III, which contains the computations for this curve, it will be seen that since Table I contains offsets for only 12 stations, each end of the curve was calculated separately instead of continuously from one end to the other. As a consequence, the offsets in Column 3 below the double horizontal line were obtained by adding the values in Column 4 to the previous offset from the bottom upward instead of from top to bottom. In other respects, however, the procedure is the same as in the first example, except that in obtaining the offsets for the two stations at each end it was necessary to apply the ratio $\frac{0.06}{0.10}$, or 0.6, to the offsets in Table I before they could be used.

In order to demonstrate the application of this method in selecting a vertical curve for a given set of conditions Figure IV is used as an example. For this situation it was determined that the curve should have a value of V of 2.9 ft. plus or minus. If a curve having a value of K of 0.10 per cent were installed at this location, its length would be $\frac{0.61 + 0.33}{0.10}$ or 9.4 stations. From Table I the V for this curve is found to be 1.1045 ft. and, by use of the ratio $\frac{V_2}{V_1} = \frac{K_1}{K_2}$ K for a curve having a value of V of 2.9 ft. equals $\frac{1.1045 \times 0.10}{2.9}$, or 0.0381 per cent. Therefore, if the final curve is given a value of K of 0.04 per cent, the length becomes 23.50 stations and the value of V is found to be 2.76 ft. From this point the offsets and elevations are calculated in the same manner as described in the previous example.

For highway and other work where steeper grades are encountered, the offsets given in Table I may be increased to those for a 1.0 per cent rate of change of grade by shifting the decimal one place to the right.

Substructure Failures Result in Accidents

NO train accidents involving bridge failures have had such serious consequences in recent years as the two that occurred within less than a week during the past summer. The first of these, involving the undermining of a pier in the Pennsylvania's bridge over the Anacostia river near Washington, D. C., occurred on August 24, and the other, involving the undermining of an abutment in the bridge over Blue Water creek on the Southern Pacific near Hargis, N. M., occurred on August 29. Because these two accidents resulted in the death of 13 persons and injury to 66 others, and because the reports issued by the Bureau of Safety of the Interstate Commerce Commission cite negligence on the part of the railways as contributing to the circumstances leading to these accidents, we present summaries of these two reports below:

The Accident Near Hargis, N. M.

The bridge across Blue Water creek consists of a 90-ft. deck girder span over the channel of the stream, supported on two concrete piers and flanked by 60-ft. deck girder spans, which were supported at their outer ends on what are commonly known as bank blocks or pocket abutments. The two piers rest on rock about 57.5 ft. below base of rail, while the two abutments, which extended only 16 ft. below rail level, were supported on reinforced concrete piles driven to a depth of 45 ft. below base of rail. They were of the U-type with short rear-extending wing walls, the head of the embankment sloping towards the stream from the rear of these wing walls so that the toe of the slope, at the rear of the piers, was about 44.5 ft. below the track. After the accident, the toe of this slope was 56.4 ft. below the base of rail.

This bridge was built in 1914; in 1931 a bridge for a new highway was built 150 ft. upstream and parallel with the railway bridge, but with its transverse axis about 50 ft. west of the center of the main span of the railroad bridge. This fact, together with the fact that the stream is required to make a sharp curve in passing under the highway bridge, had the effect of directing the flow against the foot of the railroad embankment between the east pier and the east abutment. There is no record of any conference between the railway and highway engineers concerning the location of the highway bridge in this position and no provision was made for the pro-

tection of the railway embankment by placing rip rap at the toe of the slope. However, no floods occurred in the creek subsequent to the construction of the highway bridge until early in August of this year, following which several ranchers living in the vicinity and users of the highway noticed that the toe of the slope from the east abutment was being eroded to an extent that permitted an appreciable flow behind the east pier.

Testimony presented by the division engineer and members of his staff indicated that none of them had been concerned about the conditions at this bridge, and that neither the roadmaster nor the section foreman had noted the conditions observed by the local residents. The foreman testified that he examined the bridge during the storm on the night of the accident, about three hours before it occurred, but that what he could see by the light of a flash light and a lantern did not alarm him. He said that "the embankment slope appeared in good condition."

The train involved in the accident, an east-bound passenger train of nine cars, was traveling at about 20 m.p.h., because of slow orders concerning other points in the vicinity, when it reached this bridge. The east abutment settled under the weight of the locomotive, pulling the east girder span off the pier. Five cars followed the locomotive and tender into the space behind the east pier and the next car fell over the side of the main span. The conclusions of the Bureau of Safety were in part as follows:

"This accident was caused by high water from heavy rainfall undermining the earth fill supporting the east abutment of Bridge 1623.27, resulting in the collapse of the eastern span of this bridge under the engine of train No. 4. The evidence is convincing that the failure of this bridge could have been guarded against by rip rap, wing walls or other similar protective devices. Had a comprehensive survey been made by competent railroad engineers, the changed hydraulic conditions at this point, as a result of the construction of the highway bridge, should have been recognized. Furthermore, it was brought out that as a result of rains earlier in the month of August, the east bank of the stream between the bridges, as well as the toe of the fill near the east pier, had been washed away to an extent clearly indicating the need for protection of the railroad embankment. However, the railroad company had not made sufficiently frequent or thorough inspections to discover this condition, and because of this failure to discover and heed the warning given by the partial washing away of the embankment earlier in the month, and to provide the protection which was then urgently required, the railroad company failed in the performance of its duty to the traveling public. This investigation indicates the necessity for railroad engineers to keep currently informed in regard to changes which may affect safety of railroad operation resulting from construction or other developments adjacent to their rights of way."

The Accident Near Washington, D. C.

The bridge across the Anacostia river is a double-track structure of four spans, of slightly more than 65 ft., center to center of piers, which are on a skew of 46 deg. The substructure consists of deck plate girder spans on a substructure constructed for four tracks. The center pier, which was the one involved in the accident, consisted of a stepped concrete footing 9.37 ft. thick surmounted by an ashlar stone masonry shaft 13 ft. 9¾ in. high, which was subsequently capped by a reinforced concrete bridge seat 16 in. thick. The footing was supported on a stratum of gravel about seven feet thick, into which it penetrated about two feet. The Anacostia river is a tidal stream with a drainage area of about 133 sq. miles. Its average normal depth at the bridge is from 3 to 4 ft. at mean low water, while the normal tide variation is about 3 ft.

The accident occurred at about 3:30 a. m. on August 24, following an unusually severe tropical storm on the previous day. The train involved in the accident was a south-bound passenger train of 10 cars, traveling at a speed estimated at from 30 to 50 m.p.h. The locomotive and all of the cars were derailed in various positions, two of them being thrown into the river. Examination of the bridge after the accident showed that the center pier had been undermined, resulting in the complete submergence of a portion of it and the serious settlement of the rest of it.

Statements were made by the section foreman and by the engine crews of trains that crossed this bridge only a short time before the accident to the effect that they saw nothing to indicate that anything was wrong at this bridge. According to the testimony of engineers in charge of the design and construction of this bridge in 1904, the construction of the pier footings on natural foundations in the gravel bed was founded on what they deemed sound judgment. The gravel was of a character that would have made pile driving difficult, and it was believed that the material would resist erosion in the moderate stream velocity encountered in this location.

No Under-Water Inspection Made

The bridge inspector and the master carpenter testified as to the bridge inspections made, stating that these were confined to the portion of the structure exposed above water; that it was not the custom to investigate conditions below water when there was no evidence of any cracking of the masonry. The evidence also developed that no soundings had been made at the site of this bridge since its construction. It was also shown that officers of the railway were aware that dredging had been in progress in the river a short distance down stream from the bridge, and also that the government engineers had made soundings on the site of the bridge in 1928 which showed appreciable scour since the date of previous soundings. Furthermore, soundings taken after the accident indicated that further scour had occurred in the vicinity of the center pier, since those made in 1928.

Considerable testimony was also offered concerning the severity of the tropical storm which occurred prior to the accident and which resulted in tides far greater than those normally experienced in this location. The following are abstracts from the conclusion of the Bureau of Safety:

"It appears that the railroad company had made no underwater inspection or taken any soundings for the purpose of detecting possible scour at any time subsequent to the building of the bridge in 1904, although soundings made by United States engineers in 1928 indicated that there had been some scouring or at least a considerable lowering of the bed of the stream between the center and the south piers. There is no doubt that the existing flood conditions completed the undermining of the center pier sufficiently to cause its collapse under train No. 147. Inspections and soundings to discover evidence of undermining should be made immediately after the occurrence of flood conditions, before the waters have had a chance to fill in the scouring which may have been created. There had been previous heavy rains in the territory drained by this river which might well have resulted in scourings, and careful inspection and the taking of soundings

immediately following such flood conditions might have developed a necessity for action which would have prevented the occurrence of this accident.

"Some question was raised at the investigation as to whether dredging operations carried on below the bridge might have had some bearing on what occurred. There is no positive evidence on this point, and even so, it was the duty of the railroad company to keep informed concerning changes which might have any effect on the safety of its bridge, and to take such precautions as were necessary under the circumstances."

A New Process for Heat Treating Rail Ends*

By J. H. Critchett,
Vice-President, Union Carbide & Carbon Research Laboratories, Inc.

[This paper was prefaced with a brief review of the early developments in the application of the oxy-acetylene process for heat treating, primarily to gear teeth. Reference was made also to certain automatic processes employed in England, but the body of the paper related exclusively to the heat treatment of rail ends and is abstracted below.—Editor.]

THE application of oxy-acetylene hardening that has received the greatest publicity in this country is the hardening of rail ends. I believe the Chicago, Milwaukee, St. Paul & Pacific was the first to do this in a large way.† In this process, a hand welding torch is used to heat the rail ends to a temperature above the recalescence point. The rail end is then quenched by pouring a definite amount of water on it. This leaves the rail ends in an extremely hard and brittle condition, but a second reheating with a hand welding torch reduces the hardness to the desired degree. The temperature for quenching is determined pyrometrically and the temperature of drawing is controlled by the simple expedient of heating until a piece of solder drawn across the surface will melt and slightly tin the steel. This process has the advantages that it can be done in track, that the apparatus is readily portable, and that the controls are suitable for use in the field by regular track welding crews.

A New Process

A still further improvement of the method of hardening rail ends by the oxy-acetylene method has been put into practice during the past year by the Oxweld Railroad Service Company. It differs radically from the earlier method in the use of a very much larger oxy-acetylene torch and the elimination of the water quenching. This new method depends upon the use of a sufficiently large oxy-acetylene flame so that the surface of the rail to be hardened can be brought to a proper temperature before the rest of the rail has been materially heated. Simple conduction of heat makes the cold rail metal act as the quenching medium and the rate of quenching is such that the rail is left automatically at the desired hardness.

The apparatus for carrying out the process consists of a frame which is placed across the rails and serves as the support for tips that supply six large oxy-acetylene heating flames. Three of these flames play on the end of each rail at a given joint, and provision is made for oscillating the flames through a small arc so that the top surface of the rail is uniformly heated to an average depth of $\frac{1}{8}$ to $\frac{3}{16}$ in. The time required for heating is 15 sec. and the metal thus heated is rapidly cooled through the critical temperature by the process of metallic conduction.

A fact that may seem surprising at first, though not on second thought, is that the rate of quenching is independent, for practical purposes, of air temperature, winds and other outside influences. In fact, the method has been used with equally good results whether the surrounding temperature was 20 deg. below or 110 deg. F. above zero. This is due, of course, to the fact that the results are controlled principally by the heat conductivity of the metal and this is proportional to the difference in the temperatures of the hot and cold metal. The steel must be heated above about 1400 deg. F. in order to be hardened, and when the hot metal is at this high temperature, there is not a great deal of difference in the temperature gradient whether the cold metal is at 0 deg. or 100 deg. F.

Physical Results Obtained

Measurements taken in a great number of applications have shown that the Brinell hardness of the treated metal was increased about 100 points. For example, if the original hardness of the rail head was 260, the treated metal has a hardness of 350 or better. The final hardness of the rail is controllable within certain limits, although the greater the surface hardness, the shallower will be the thickness of the hardened layer. The apparatus and the method have been applied successfully to both the head-free and the standard types of rails, in sections ranging from 100 to 135 lb. per yard, and the pattern of the hardened area can be controlled almost at will. Without gas cylinders the machine weighs about 50 lb., and is readily moved from one joint to another by two men.

The speed with which the operation is carried out leads to economy in gases and the crew is small, so the actual cost per joint is very low. The only control is a single valve which is operated on a time cycle which is not very critical, and hence does not require expensive labor or supervision. Technically, the degree of hardness can be controlled within desirable limits, and the nature of the operation is such that if the operator for any reason varies from the standard conditions which have been set for him, the rail will be left in a safe condition.

The Principles Involved

This method of heat treatment depends on two things: The heat conductivity and the heat capacity of the metal integral with the part that is being heat treated. Both of these are inherent properties of the steel not subject to change but whose laws are understood and hence capable of direction. The heat conductivity of steel is sufficiently high so that this factor does not usually require special consideration. Since the unheated portion of the steel is to serve as the quenching medium, it must bear such relation to the highly heated part that it can quickly absorb the quantity of heat above the recalescence point in the part that it is desired to harden. The balancing of these factors, that is, the quantity of heat above the recalescence point and the capacity of the rest of the metal to absorb heat determines the rapidity of the quenching and hence the hardness of the part being treated.

*Abstracted from a paper read at the thirty-fourth annual convention of the International Acetylene Association, Chicago.

†This process was described in detail in an article in *Railway Engineering and Maintenance* for December, 1931, page 1040.

What's the Answer?

Have you a question you would like to have someone answer?

Can you answer any of the questions listed in the box?

To Be Answered in February

1. In preparing stock rails for housing switch points, should they be milled, ground or bent to shape? Why?

2. Should one or two lines of pipe be used for jetting piles? How should they be placed? Of what size and shape? What pump pressure should be maintained?

3. How should a track chisel be held when in use? What are the effects of holding it improperly? How should it be struck? Why?

4. What is the effect of air pockets in suction lines? How can they be overcome?

5. Where portable cans or torches burning gasoline or other volatile fuels are employed to remove snow from switches, what precautions should be taken to reduce fire and personal-injury hazards?

6. What are the disadvantages in the use of salt for removing ice from station platforms? The advantages? What other methods of removing ice are practicable?

7. What are the advantages of stone, as compared with gravel ballast for heavy-traffic lines? What disadvantages?

8. Where creosoted-timber trestles are in service, to what extent should stocks of treated piles and timbers be kept on each division for emergency purposes?

Fighting Snow

What methods should be followed in keeping a line open during moderate snow storms? How do these methods differ as the snowfall becomes heavier but does not drift? When it is relatively light but drifts? When a heavy fall of snow is combined with severe drifting

?

Much Preparatory Work Is Essential

By W. J. H. MANNING
Division Engineer, Delaware & Hudson, Plattsburgh, N. Y.

Considerable preparatory work and a well-developed organization of the maintenance forces are essential to keeping a line open in snow country. The preparatory work is of two kinds: (1) Permanent and (2) temporary. The permanent measures comprise a general program of widening cuts, planting trees for snow stops, erecting permanent snow fences, and other lasting arrangements for preventing the snow from reaching or piling up on the tracks.

Temporary work, which must be repeated annually, includes the erection of flanger signs, cleaning ditches and culverts, marking culvert headwalls where necessary, providing draininge at switches, placing brooms at switches for the use of train crews, installing switch heating equipment, repairing and erecting portable snow fences, conditioning and locating at strategic points such equipment as snow plows, flangers, spreaders, etc. At the same time the section forces should be provided with the necessary tools and supplies, including brooms, shovels, salt, etc.

In organizing the forces, every foreman, every operator of snow plows and other equipment and other key men should understand exactly what is expected of them. A chart should be prepared showing the territory to be covered by each man and piece of equipment. On this chart should be recorded the residence and telephone numbers of operators and relief operators.

Roadmasters should assume responsibility for keeping open all tracks under their jurisdiction. It is essential that they be in close touch with the dispatcher during the storm, and know what trains are moving over the road. Likewise, the section foreman should be held responsible for his section and should report frequently to the roadmaster, giving him full information as to the amount of snow, the direction and intensity of the wind and whether the snow is drifting. He should also express his opinion as to the further progress of the storm, indicate points of difficulty on his section, and state the number of men out and what they are doing. Foremen should be kept advised as to what assistance they may expect in the way of additional forces or equipment, the trains that are moving, whether these trains will likely use any of the switches on their sections, and the approximate time of their arrival.

If a moderate storm begins at a time when the track is clear of snow, the foreman should ascertain what trains are moving and call a sufficient number of men to clear switches, station platforms, turntables, etc., in time to permit their use when needed. If the snow becomes heavier but does not drift, the snow plow or flanger, as may be needed, should be ordered out as soon as it becomes apparent that there may be enough snow to delay trains. The amount and character of the traffic may determine this action. If the snow-fighting equipment can be held until the storm is over, the snow can be cleaned out better and at less cost. After each storm steps should be taken immediately to prepare for the next one.

When the snowfall is relatively light but drifts, fore-

men should inspect all snow fences to ascertain whether they are functioning, and should erect emergency fences or snow blocks where required. They should note points where permanent snow fences would be beneficial. They should inform the roadmaster whether they can shovel out the drifts or whether a snow plow will be needed. The roadmaster should advise them whether the snow equipment will be run so that they can arrange their work accordingly.

When a heavy fall of snow is combined with drifting, the general procedure is about as already outlined. In this case all available men should be called out, including extra forces, and all equipment thrown into the fight. Foremen should be kept informed of the movement of this equipment and they should confine their efforts to such work as the plows or flangers will not do ahead of trains. Snow plows and flangers should be run immediately ahead of all important trains, the intervals generally being a station apart. During the storm, attention should be concentrated on keeping trains moving. Cleaning up, widening cuts, providing drainage, etc., can be cared for after the storm is over. This work should be part of the preparations for the next storm.

Success in keeping a line open during snow storms depends as much upon close co-operation between the operating and maintenance departments as it does on the actual efforts of the maintenance forces. The responsibility for fighting snow should rest on one man on an operating division, and his request for priority in the movement of trains should be followed.

Drifting Snow Requires Heavy Battle

By H. L. STEIN
Roadmaster, Chicago, Burlington & Quincy, Edgar, Neb.

During a moderate snow there should be no difficulty in keeping the line open. The only troublesome places will be interlockings, remote-control switches, spring switches, etc. It is assumed that all preparatory work, including the placing of brooms at main-track switches, has been properly attended to. As a precaution, during the first storm, a train order should be addressed to all train and switching crews notifying them to make certain that all switches are clear of snow and ice both before and after use, and that the points fit properly.

Where there are no snow-melting devices, the foreman should station promptly enough men at interlockings, remote-control and spring switches to insure that they will be kept clear and working properly. The foreman should be held responsible for making these assignments at any hour of the day or night when the storm breaks, without waiting for or depending on a call. In busy switching yards, it pays to assign a few men to switching leads. Freight and passenger platforms can generally be cared for temporarily by the station forces. On outlying sections, no increase of forces is generally necessary. The first duty here should be to flange out highway crossings, especially those that are heavily traveled. Continued travel over crossings drags in the snow and packs it in the flangeways, and may thus create a dangerous condition.

If the snowfall is heavy but does not drift, the procedure is much the same, except that extra men will be needed. Here accumulations of snow are likely to affect the situation. During the storm, only temporary removal should be attempted. Spreaders can be used along switching leads and to clear series of yard tracks by temporarily blocking a track or two between adjacent groups of cleared tracks. Horse or tractor-drawn plows can be employed to drag snow away from switch stands, interlockings and passenger and freight platforms.

In a drifting snow storm the maintenance forces have a heavy battle from the start. Large extra forces may be required to keep the line open. Foremen and roadmasters should be specially alert to keep in touch with developments and authority should be granted them to exercise their judgment as to the force needed and when to put it on. A storm of this kind often requires an army of men, and the situation may get out of hand if the forces are not available when first needed. Normal train movements should be curtailed and only such trains run as are absolutely necessary. If freight trains are moved, they should operate with sharply reduced tonnage.

All efforts should be concentrated on keeping the main tracks, selected passing sidings and yard tracks open. Snow plows should be started as soon as the character of the storm becomes evident, and kept in operation until it is over. An extra run of a snow plow costs less than to have a train stalled; for a train stalled in a snow drift may block an entire operating division for hours, and sometimes for several days. For these reasons, if there is a probability of the line becoming blocked, trains should be held at terminals or tied up until the storm abates or snow plows have gone through.

Every snow plow outfit should carry a gang of laborers. If practicable, the roadmaster or road foreman of engines should go along. Snow plows should be run with two locomotives. Where push plows are used, drifts of dry snow should be hit with both locomotives in operation, while if the snow is wet or icy, the rear engine should be cut off and used to drag the snow plow out in case it gets stuck.

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Cleaning Roadside Tanks

What instructions should govern the cleaning of roadside water tanks where an untreated muddy water is used? Where the water is filtered, is clear well water or is obtained from a reservoir? Where it is pumped unfiltered from a lime-soda ash softening plant? Where it is treated with compounds in the roadside tank ?

Uniform Instructions Are Impracticable

By E. M. GRIME
Engineer of Water Service, Northern Pacific, St. Paul, Minn.

Conditions with respect to the storage of water in roadside tanks include such a wide range that uniform instructions relative to cleaning tanks are usually impracticable. For this reason, in large measures, this matter must be left in the hands of those directly responsible at each service point for the quality of water delivered to locomotives.

Where water is pumped directly from a stream or lake, quantities of mud or other debris, such as algae, are often delivered directly to the tank. In such cases, cleaning once a year is usually desirable, while it may be required more often, depending on the degree and duration of the turbidity of the water. In some instances, where the water is obtained from deep wells, enough sand may be brought up with the water to cause an accumulation that will require removal once a year. In other instances, the water may be so clear that cleaning can be deferred indefinitely. Even where the supply is obtained by gravity from mountain gulches, in which the surface is largely bare rock, intakes should be protected by suitable screens to hold leaves and other floating material. If this is done the deposit may not re-

quire cleaning oftener than once in two or three years. In other instances, mountain streams may become quite turbid during spring or summer freshets, and cleaning once a year is required.

In some designs of lime-soda and ash softening plants, the tank is employed for both storage and settling purposes. Here the clear water near the surface is drawn off by means of a floating inlet pipe, the precipitated solids being allowed to collect in the lower section of the tank. Such tanks are usually cleaned daily by means of a perforated-pipe sludge-collecting system on the floor, through flush valves that discharge into a sewer.

Where wayside treatment is employed, chemical compounds are added directly to the water as it is pumped to the storage tank. Under ordinary raw-water conditions, there is rarely enough chemical reaction in the tank to cause much accumulation of sludge. This will depend largely on local conditions, however, and experience will determine in each case the proper intervals between cleanings.

Flat-bottom wooden storage tanks, as usually designed, have the upper end of the outlet pipe or the tank valve raised from 12 to 18 in. above the floor. In most railway steel storage tanks the combination outlet and inlet pipe ends several feet above the base of the water leg, which is five or six feet in diameter. There is, therefore, space for the accumulation of considerable sediment before cleaning becomes necessary.

It will be seen from the foregoing that a complete knowledge of all of the local conditions is essential to determine in each case the proper regulations with respect to the frequency of tank cleaning.

Determined by Character of Water

By Water Service Inspector

The frequency with which roadside tanks should be cleaned is determined by the character of the water. As a rule, flat-bottom tanks do not need cleaning oftener than once a year. This is particularly true where the water is obtained from wells, city supplies, reservoirs and even from streams where the water is softened by the lime-soda ash process and filtered. Tanks should be emptied and examined annually, however, regardless of the need for cleaning.

Where the supply is from a stream which carries considerable suspended matter, it may be advisable to clean the tank twice a year, say after the fall rains and again in the late spring or early summer. I have never found it possible, however, to follow a set rule or prepare a schedule which can be applied at even an individual water station, let alone a blanket schedule that can be followed at all stations alike. About the only general rule that can be followed as to the time of cleaning is to avoid doing this during freezing weather.

Where water is pumped unfiltered from a lime-soda ash softener to the storage tank, the frequency of cleaning will depend entirely on the efficiency of the settling basin. If ample time for settlement is provided, sludge should accumulate slowly and cleaning once a year should be sufficient. If the roadside tank is a combination storage and treating tank, it will be equipped with a sludge removal system which should be operated once or twice daily, as required.

Where compounds or other chemicals are placed directly in the water in the storage tank, it may be necessary to clean the tank at more frequent intervals, or in other cases, particularly where the chemical reactions occur in the boiler, only at long intervals. Again the length of the period between cleanings may be a function of the amount of water used. Frequently the suspended matter which results from the introduction of the compound into the raw water is of a light flocculent character, which can be readily removed by emptying the tank through a water column line or washout plug.

If I were issuing instructions I would prepare them to require that flat-bottom tanks shall be examined once every year and cleaned as frequently as required. Conical-bottom tanks with mud drums shall be blown off once a week where the water is muddy or sludge accumulates rapidly. If the water is clear, once a month is sufficient. The date of the last cleaning should be stenciled on the tank supports and should be shown on inspection reports.

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Standardizing Building Details

To what extent can building details be standardized ?

Much Can Be Accomplished

By A. T. HAWK

Engineer of Buildings, Chicago, Rock Island & Pacific, Chicago

Much can be accomplished along this line. In fact, we have developed many standard details for parts of buildings that are common to a large number of our structures, which we use in designing new buildings. As an example, we have one sheet covering details of mouldings that are standard. They are numbered individually to conform to the uniform system of numbering that is employed by all mill concerns. We also have sheets of fully developed details covering many types of windows and doors that are used in various classes of buildings, both brick and frame. These sheets are in complete detail so that they may be used to accompany general plans and elevations.

We have other sheets that give the details of construction for typical floors, roofing, etc.; for typical plumbing and fixtures, including enclosures for bathrooms, toilets and showers; and to cover standard arrangements for heating, on which are shown typical radiator piping systems and other piping details.

In addition to the foregoing, we have standard plans for freight, passenger, baggage-room and ice house platforms; telegraph tables; shelving for storehouses and for freight house and passenger station records; manhole catch basins, water-meter pits, cisterns and water crane pits; coal boxes, battery sinks and racks, firehose racks and lamp stands; iron and wood fences, crossing gates and roadway signs; smoke jacks and ventilators; electric lighting fixtures and posts; sand-drying fixtures and tanks; painting and lettering; and typewriter cabinets. We have standardized still further on building details, but the whole list is too long to mention here. The foregoing will, however, give an idea of the wide range of details for which standardization is practicable.

Can Be Developed Over Wide Range

By Supervisor of Bridges and Buildings

Probably every railway of importance has in use standard plans for small and medium-sized passenger stations, enginehouses, section tool houses, company dwellings, flagman's and switchman's shanties and others of the more than 125 distinctive types of structures that must be maintained. While standardization is practicable and satisfactory for certain classes of buildings, such as those that have been mentioned, and demonstrates marked economy in construction and maintenance, stand-

ards for buildings as a whole cannot be applied for many other classes, as for example, the more pretentious passenger stations, larger freight houses, important offices, shops, power houses, etc.

Although standard general designs may not be practicable for many classes of buildings owing to the necessity for varied architectural treatment, this need be no bar to standardization of many of the details of construction. There is an attractive opportunity to reduce maintenance expense by standardizing on a few sizes of window glass, as every maintenance officer knows. Logically, this leads to standardization of sash and window frames. Other items that can be standardized without introducing monotony or suppressing the individuality of buildings that are specially designed, are doors and frames, ticket windows, ticket counters, cashiers' windows and counters, stationery cases, ticket cases, shelving for records, telegraph tables, office tables, basement windows, plumbing and fixtures, toilet partitions, floors, roofing, trim, seating, platforms for passenger and freight stations and others too numerous to mention.

Enthusiasm for standardization may lead to complete inflexibility of design and this may be worse than complete lack of standardization. Standardization does not mean necessarily one design only for a given detail. It may mean several, each of which is applied under certain conditions. Properly conceived and utilized, standardization of building details can be applied over a wide range of items to marked advantage with respect to construction and maintenance costs, yet without hampering the architectural development of the railways' structures.

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Surfacing Frozen Track

Should track be surfaced in the early winter after frost has penetrated to a depth of two or three inches? If not, how can rough track be corrected? Can track be lined at this time ?

Not Where It Can Be Avoided

By W. RAMBO

Roadmaster, Missouri Pacific, St. Louis, Mo.

As a general practice, track should not be surfaced after frost has penetrated to a depth of two or three inches. If possible to do so, main line tracks should be surfaced and in every other way put in condition to enter the winter before freezing weather arrives. If this is done, winter surfacing will be held to a minimum. If it becomes necessary, however, to surface soft spots after frost has penetrated to a depth of two or three inches, it can be done. The track can also be lined at this time as it will have been stirred and broken loose from the frozen ballast.

While it is undesirable to surface and line track after frost enters the ballast, it can be done. In fact, if the frost has not penetrated more than two or three inches, it is best to do so rather than to shim and spike line.

It Is Possible, But Not Desirable

By W. E. TILLETT

Assistant Foreman, Chesapeake & Ohio, Marysville, Ky.

Track should be put in such condition of line and surface prior to winter that it will be unnecessary to disturb it after the ballast becomes frozen, and especially after frost has entered the roadbed. As a general practice, it is highly undesirable to surface or line track after it has frozen; yet there are numerous instances, such as after derailments, at points where soft spots have developed, etc., where it becomes necessary to do so.

Under the particular conditions mentioned, there is no alternative to surfacing and lining in the usual manner. When a soft spot occurs, the first, although mistaken, effort at correction is usually to apply ballast, and these applications are continued until the water pocket that forms is cured by drainage. As a result of this action, there is usually a considerable depth of clean ballast directly under the ties, which does not freeze solidly, thus permitting the track to be surfaced and lined with relative ease. After track is frozen, there is but one alternative to surfacing by tamping the ties and lining with bars. This other method is to spikeline the rails and place shims to correct surface irregularities.

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Replacing Stringers

How should one go about replacing a stringer in a creosoted ballast-deck trestle? The placing of one or more additional stringers to reinforce the deck ?

Different Designs Require Different Methods

By L. G. BYRD

Bridge and Building Supervisor, Missouri Pacific, Poplar Bluff, Mo.

There are several types of ballast-deck trestles and the methods of replacing stringers vary accordingly. It has been my observation that in each of these types, there has been a tendency to remove stringers earlier than was necessary. In other words, bridge officers, who had received their training when untreated timber was used universally and was both plentiful and cheap, did not readily change their practices when treated timber came into vogue. For this reason many treated stringers have been removed before their potential service has been obtained.

From the standpoint of economy, stringers and caps should not be removed in all cases where decay is becoming evident. Often such decay is only on the surface. If such a timber does not show signs of crushing, evidence of decay may not be an indication of approaching failure. In this case, boring tests should be made and if the timber is sound, it is seldom that it will not last for several more years. The test holes should be treated and closed immediately with creosoted plugs.

Among the early types was one in which the stringers, except the outside ones, which were continuous over two spans, were one span long and packed so closely that decking plank was not required. Quite a few of these trestles are still in service. In this type it is necessary to remove the ballast, and preferably the track, and lift the stringer out from above, no scaffold or rigging being required.

In a later design the stringers were spaced wide enough to permit the insertion of additional stringers in the event that the deck needed strengthening. In this design the outside stringers lapped the full width of the cap while the intermediate ones butted against those of the adjacent span. This type has decking plank of 3-in. or 4-in. material either 8 in. or 10 in. wide. Obviously, it is a simple matter to replace the outside stringers, which are usually the first to show evidence of decay, owing largely to the boring of holes for bolts to attach the ballast retainers. In a later modification of this type, which is the design now most commonly used, all of the

stringers are lapped to give a bearing the full width of the cap.

To replace an intermediate stringer in either of these designs, the deck must be raised enough to allow the old stringer to be removed and the new one inserted, in either case with one end depressed until the timber has been shifted endwise enough for the lower end to clear the cap.

To do this, jacking foundations are prepared on both sides of the bents involved and shores are then set between the jacks and headers on either side of the stringer or stringers to be replaced. The operation can often be facilitated by removing one of the deck planks and using a line to raise and lower the stringers.

On the Missouri Pacific our ballast decks consist of eight pieces, 8 in. by 16 in. by 14 ft., and two pieces, 8 in. by 16 in. by 26 ft. The span is thus 13 ft. and the width of the deck for single track is 13 ft. The stringers are lapped so that additional stringers cannot be inserted. The deck planks are 3 in. by 10 in., which are fastened to the stringers with 60-penny nails. When a stringer is to be replaced, we usually saw out a section about 20 in. long and allow the timber to fall out. The nails are then backed out of the deck planks and the new stringer is inserted in the manner already described. It is not necessary to redrive the nails, since the stringer is held against movement by means of an angle which is also fastened to the cap.

The foregoing methods are adapted for trestles up to 15 ft. high. If the trestle is higher or the bents stand in water, the method of raising the deck for replacing caps, as discussed on page 100 of *Railway Engineering and Maintenance* for February, 1932, can be employed successfully.

Careful Preparation Facilitates Renewal

By C. H. WOODRUFF

Draftsman, Engineering Advisory Committee, Chesapeake & Ohio, Cleveland, Ohio

Carefully inspect all stringers, noting on a sketch the exact size, spacing, length and soundness of each. Measure accurately the distance between caps of adjacent bents and show the size and length of cap on the sketch. Also, indicate all fastenings, such as bolts, angles, wood screws, drift bolts, etc., that can be seen. From this information the new stringer can be framed and made ready for insertion before the bridge is disturbed. The weight of the structure above the caps should be carefully calculated to insure provision for ample lifting capacity, since ballasted-deck trestles are usually much heavier than is realized. They may weigh as much as 2,500 to 3,000 lb. a lin. ft., or as much as 20 tons a panel.

To prepare the bridge, pass two ropes under the track rails, one on each side of the bent at which the lift is to be made, and allow the ends to hang well below the deck on either side of the track. From one rope suspend a scaffold. To the other, secure a 12-in. by 12-in. or larger timber and draw it snugly against the bottom of the stringers. Next, construct, about 4 ft. on each side of the center line and directly under this timber, two sets of mud sills of sufficient size to distribute the load to the soil. On each of these place a 15- or 20-ton, quick-acting jack. Set a 12-in. by 12-in. shore on each jack, providing a bearing plate between the jack and the shore.

Next jack the stringers high enough to permit the insertion of 2 in. or thicker shims, omitting the shims under the stringers that are to be shifted or removed. Cut all bolt or nails that interfere with the work. If the stringers are one panel long, the work of placing an inner stringer is greatly facilitated. Ordinarily a raise of 4 in. will provide sufficient clearance for pulling out the old stringer and inserting the new one. Adjacent bents should be jacked about 2 in. and shimmed. To reduce the load on the jacks, angle bars should be taken off, and if the lift that is required is greater, the rails should also be removed.

If the stringers are continuous over two spans, and are closely spaced, they should be cut before removal and the replacement stringers should be one panel long.

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Adding Anti-Creepers

Where additional anti-creepers are needed, should they be applied in connection with tie renewals, surfacing, etc., or should their application be deferred until winter? Why ?

Summer Best Time to Apply

By Division Engineer

Where additional anti-creepers are needed, it is almost certain that the ties previously anchored have moved and are, therefore, improperly spaced or not square with the track. In general surfacing, these ties should be straightened and respaced. In this event, all anchors not in contact with the ties should be replaced. At this time, also, the additional anti-creepers should be placed so that all of the anchors will have a proper bearing against the ties. Where tie renewals are being made without giving the track a general surface, it might be difficult to apply the anti-creepers successfully, since few of the new ties are likely to be needed at the points where the anchors should be applied.

If additional anti-creepers are needed on track that is not to be surfaced and on which the ties are not to be spaced, they should be placed during the summer when the rail is fully expanded. At this time all of the anti-creepers already in service have full bearing on the ties, but in winter the rail will be contracted and some of the old anti-creepers will be backed away from the ties. New anti-creepers applied during the latter season and given a full bearing against the ties would be compelled to bear the burden of expansion, with the probability of moving the ties against which they bear.

Better to Apply When Needed

By H. S. TALMAN

Supervisor, Chesapeake & Ohio, Thurmond, W. Va.

Additional anti-creepers can be applied more economically in connection with surfacing and tie renewals. At this time the track is cribbed in whole or in part, ties are being spaced and, generally, the old anchors have been removed. It is a small matter, therefore, to add such anti-creepers as are needed when the old ones are being re-applied. The only disadvantage is that only a few anti-creepers are applied every day, so that the stock moves slowly.

Track that needs additional anchorage may not need surfacing or tie spacing, but if the anti-creepers are not applied, the cost of driving and regaging the rail and spacing the ties will be considerably increased when it is done during the following season. The only advantage in making the application during the winter is the quicker disposition of the material stock. If the standards of a road require the cribs to be filled to the top of the

ties, the cost of application will be very much increased, however, particularly in sections where the ballast freezes.

Additional anti-creepers should always be applied as soon as the need for them is apparent. If they can be applied in connection with surfacing or tie renewals, this should be done. If the track is not to be worked, one should make the application at once if he expects to obtain the maximum return on the investment.

Should Be Done During Working Season

By JOHN W. RIGGANS

Track Supervisor, Baltimore & Ohio, New Castle, Pa.

I recommend the application of additional anti-creepers during the progress of surfacing and tie renewals, as the time involved is so small that it is nearly negligible. In addition, the track is given anchorage at a time when it is needed. If the application is deferred until winter, the inadequately anchored rail is given an opportunity to creep and the expansion will be bunched. After this occurs, considerable time and expense are required to drive the rail to secure uniform expansion gaps. Again, if the work is deferred until winter, one must contend with snow, ice and frozen ballast. During the working season, foremen can take a supply of anti-creepers out every morning and apply them during the day as the work progresses with practically no loss of time. The longer the application of needed anti-creepers is deferred, the greater the adjustment that must be made in expansion when they are applied.

[Additional replies were received from W. Rambo, roadmaster, Missouri Pacific; W. E. Tillett, assistant foreman, Chesapeake & Ohio; Robert White, section foreman, Grand Trunk Western; and J. B. Wilson, section foreman, Missouri-Kansas-Texas.—Editor]

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Turpentine in Red Lead

Does turpentine add to the tenacity of red lead when applied to steel surfaces as a priming coat? In what way? How much turpentine should be used ?

Excess Turpentine May Impair Tenacity

By E. C. NEVILLE

Bridge and Building Master, Canadian National, Toronto, Ont.

Red-lead paint is universally conceded to provide the most tenacious film that can be applied to steel surfaces, but experience teaches that the adherence of a good paint can be impaired by the addition of excess driers and thinners. Raw linseed oil, with the addition of a small amount of drier, is the vehicle commonly employed for red lead, to form a workable mixture. When applied in a thin film, a chemical action is started in which the drier assists the oil to absorb oxygen and thereby harden into a firm elastic coating, the hardness of which depends on the relative proportions of oil and pigment in the mixture.

When applied to iron or steel surfaces, this paint should dry sufficiently over night so it will not be "tacky," or sticky, but in reasonably warm weather it should not be hard enough for two or three days to permit the application of a second coat. Where it is necessary to make this application sooner, the drying can be accelerated by reducing the amount of oil and substituting an equal volume of turpentine. This will result in a harder but less elastic film, owing to the larger ratio of pigment to the oil. Excessive hardness in a priming coat is undesirable because its tenacity is in inverse ratio to its elasticity. It follows, therefore, that as turpentine is added, the tenacity of the paint is decreased rather than increased.

Film Lasts Longer If Turpentine Is Low

By J. J. LaBAT

Assistant Bridge and Building Foreman, Missouri Pacific, Wynne, Ark.

In dry warm weather, where quick drying is not essential, very little turpentine is needed in a priming coat of red lead on steel surfaces. The film is thicker and will wear longer if turpentine and drier are kept low. It is well to remember, however, that a hard under coat is important for permanence in painting. It is true, in general, of both paint and varnish that quick drying decreases the durability of the film. When painting bridges and structural steel in buildings, plenty of time is usually available for allowing the paint to dry without the addition of much turpentine and drier. When paint is to be applied over an old dry coating, however, the addition of turpentine is an advantage, since it tends to penetrate the old paint and by softening it temporarily, enables the new paint to adhere better. Similarly, it enters wood surfaces, dissolving the pitch and other paint-resisting contents of the lumber, so that for priming coats on wood surfaces the addition of turpentine is essential. In damp weather or low altitudes, I would add about one pint of turpentine to 20 lbs. of red lead when it is to be used as a priming coat for steel surfaces.

Does Not Add to Tenacity. May Subtract

By FRANCIS M. HARTLEY, JR.

Sales Department, National Lead Company, New York

In a red-lead paint, the function of the linseed oil is to coat every particle of pigment. When applied on a metal surface, the linseed oil absorbs oxygen from the air and dries to a hard, tough coating, the tenacity of which depends largely on a proper relationship between the pigment and the non-volatile, or fixed vehicle. When turpentine is added to any paint to facilitate its application, it does not change this relationship, because the turpentine evaporates from the paint film. On the other hand, when some of the linseed oil is replaced by turpentine, the pigment-non-volatile vehicle relationship is changed, with the result that the dried paint film is harder but less tenacious.

It should not be inferred, however, that this is an unwise procedure. Whether it is advisable to replace some of the linseed will depend on the conditions under which the paint is to be applied and on the type of metal surface to be painted. In cold weather, paint is likely to be viscous, and unless it is brushed in unusually well, it may not adhere properly to the surface. Adding turpentine to the vehicle increases the flowing and wetting properties of the paint and allows it to spread intimately into surface irregularities of the metal.

It is a mistake to attempt to make red-lead paint from red lead and linseed oil alone. The paint should contain both turpentine and a drier. The quantity of turpentine to be used will depend on circumstances and conditions, so that not even a general rule can be stated. There is no substitute for judgment and experience in deciding this important question.

In a shop coat for steel which may not receive a finishing coat for several months, from 5 to 15 per cent

of volatile thinner should be ample. In repainting structures, where much of the priming coat is often applied over old paint, it is generally considered advisable to increase the volatile thinner to from 15 to 30 per cent to improve the bond between the new and old paints.

On certain classes of equipment, such as steel cars, it is sometimes necessary to apply the priming coat one day and the finishing coat the next. Here it may be necessary to increase the volatile thinner in the priming coat to as much as from 37½ to 40 per cent. This hastens the drying and helps to produce a harder film with less gloss. The percentages of volatile thinner that have been mentioned include the drier, which should never exceed 7½ per cent of the total vehicle.

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Line Rail on Curves

On curves, should the high or low rail be selected as the line rail? Why ?

High Rail Guides Wheels

By ARMSTRONG CHINN
Chief Engineer, Alton, Chicago

On curves, the high rail should be selected as the line rail, because wheels of equipment passing around curves crowd against and are guided by the high rail. It is common knowledge that this contact with the wheel flanges produces rapid wear on the gage side of the head of the high rail. It is obvious that pressure of the magnitude necessary to cause this wear will compel the wheels to follow the rail exactly and thus become sensitive to every variation in its alinement. Theoretically, if the gage of a curve were perfect, the curve could be lined with either rail.

Perfect gage is an ideal that is seldom attained, however, through a stretch of track of any length. For this reason, if the low rail is used as the line rail, the high rail will contain all of the imperfections of the alinement of the low rail as well as those resulting from variations of gage, and even though they may be small, they will be certain to affect the riding qualities of the track.

Line Rail May Have Several Meanings

By THOMAS WALKER
Roadmaster, Louisville & Nashville, Evansville, Ind.

Preferably, the high rail of a curve should be selected as the line rail. In using this term, I refer to the rail actually used for lining the track and not the one employed for lining the ties. A much better and sharper view can be secured of the high rail for lining than of the low rail, for the reason that the space between the rails usually contains no obstructions, whereas objects such as weeds, parkway-cable outlets, etc., may interfere with the view of the low rail.

Usually the gage side of the head of the high rail is more sharply defined than that of the low rail, since flowing metal often causes the low rail to present a ragged appearance. Furthermore, the joints in the low rail of sharp curves tend to kink in, making it more difficult to line it. To my mind, these reasons are sufficient to warrant the universal selection of the high rail for lining curves.

Consideration of methods to be followed in lining develops an additional reason for selecting this rail. In lining a curve, a foreman should always use curve chords, never trusting his eye further than for taking out minor irregularities. Since curve chords (string lining) should be taken on the high rail, in fact this practice is nearly universal, it follows logically that the high rail should also be used for sighting purposes when lining the curve.

For lining ties it seems immaterial whether the high or low rail is used. Formerly, it was our rule to use the low rail. Since we have been using prebored creosoted ties, we consider the east rail as the line rail on both tangents and curves. This rule was adopted primarily to facilitate the laying of new rail, particularly where it is of heavier section than the released rail, since it permits us to lay continuously on one side regardless of curves. Otherwise, it is necessary to go back and lay the opposite rail, at least as far as around the curve, provided the side on which the rail is being laid happens to be the line side.

The reason for this is obvious. The boring in the tie plates is not the same for both ends of the ties where a heavier section replaces a lighter one. In this case the line side should be laid first so that the spiking will come in the existing holes on this side. If both rails are carried forward simultaneously, this situation does not arise but on single track where traffic must not be interrupted, we prefer to lay one side first and gage the other side.

Low Rail Should Be in Good Line

By A. A. JOHNSON
Track Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

My experience indicates that the high rail on a curve should be taken as the line rail. Uniform gage should be maintained on all main tracks, however, with the possible exception of curves so sharp that widening of the gage is demanded. The widened gage should be uniform for the curve itself. For these reasons, the low rail should always be in as good line as the high rail.

Curves Should Be Held to Correct Gage

By W. RAMBO
Roadmaster, Missouri Pacific, St. Louis, Mo.

Unless a train is moving at reduced or relatively low speed, the wheels tend to crowd the high rail and thus become sensitive to any irregularities that may occur in the alinement of this rail. Wheels of the equipment in slow-moving trains tend to crowd the low rail, but because of the low speed, minor defects in the alinement of this rail do not affect the riding qualities of the curve. After a curve has been lined, both rails should be in perfect alinement. If they are not, it is certain that the gage is irregular. This condition should be corrected at once, for uniform gage is as advantageous on curves as on tangents.

Canadian Entrance to the Michigan Central's Detroit River Tunnel

New Devices

Develop New Wire Rope Socket

THE American Steel & Wire Company, Chicago, has developed a new type of wire rope socket, known as the Fiege Tiger-Claw wire rope socket, which may be attached quickly in the field and which is said to give 100 per cent cable strength. This device consists of three parts, a threaded socket, a threaded tapering sleeve

Cut-Away Section of the New Socket Showing the Various Parts

which screws into the socket, and a fluted tapered plug, which, when inserted within the end of the rope, spreads the strands apart and holds them firmly against the walls of the sleeve.

When applying this socket, the sleeve is inserted over the end of the wire rope, with the end of the rope protruding a specified distance beyond the end of the sleeve. The strands of the rope are then spread apart and the plug inserted between them into the end of the sleeve, using a six-fluted center plug for six-strand rope and an eight-fluted plug for eight-strand rope. The plug is then driven down by means of a punch and hammer, after which the socket is inserted over the end of the rope onto the sleeve and screwed down firmly.

Two-Stage, Air-Cooled Portable Air Compressors Developed

THE Ingersoll-Rand Company, New York, has developed an entirely new line of two-stage, air-cooled portable air compressors, which are said to offer many advantages in the way of durability, simplicity, minimum maintenance requirements, and increased efficiency of operation. The new line, which includes units with piston displacements of 125, 185, 250 and 370 cu. ft. per min., capable of operating from 4 to 24 tamping tools and a wide range of other tools in track and bridge work, are furnished with several types of wheel mountings, including a flanged-wheel mounting for operation on the track, and are also available without wheels for use on auto trucks or trailers.

The principal feature of the new line is the two-stage air-cooled compressor itself, which is of the radial type with two air fin-cooled, low-pressure cylinders and a single air fin-cooled high-pressure cylinder. From the screened air intake, the air passes two ways into the first-stage cylinders, from which it passes through an air-cooled intercooler before entering the second-stage cylinder. In the intercooler, which is of the radiator type with finned tubes, the low pressure air is cooled to within 15 deg. of atmospheric temperature, a feature which effects a saving in power and also results in increased compressor efficiency in hot climates and at higher altitudes. The intercooler functions also to remove moisture from the air being compressed and thus delivers dry air to the high-pressure cylinder and to tools. It is said that because of the intercooler the valves of the two-stage compressor are maintained 200 deg. cooler than in single-stage units, and that as a result the valves are not subject to carbonization or warping. The air reservoir or receiver is made of pressed steel without longitudinal seams.

The compressor is fitted with air-cushioned valves of heat-treated stainless steel, the two main bearings of the crankshaft are of the Timken heavy-duty, tapered-roller type. All of the compressors are driven by improved Waukesha heavy-duty gasoline engines, direct-connected to the compressors through an internally expanding clutch. An improved type of air regulator in the air intake of the compressor, in no way dependent on the action of the inlet valves, unloads the compressor automatically and the engine controller, in turn, acts on the butterfly valve of the carburetor to slow down the engine.

The new features incorporated in the engine and compressor design are said to result in the delivery of 23 per cent more air at 100-lb. pressure than can be obtained from the best single-stage compressor of the same displacement. It is also claimed that the gasoline fuel consumption of the new units per cubic foot of air delivered is 25 per cent less than the usual single-stage units.

The railroad mountings of the two-stage air-cooled units are similar to those furnished formerly with this company's Type 20 single-stage, water-cooled tie-tamper

The New Two-Stage, Air-Cooled Compressor

compressors, and can be had either in the self-propelled or nonself-propelled models. When figured on the basis of the number of tools they will operate, the new compressors weigh from 1,000 to 1,300 lb. less than the water-cooled units.

In addition to its new line of compressors, the Ingersoll-Rand Company has improved its pneumatic tie tampers and developed some new styles of tamping steels. The improved tie tamper, known as the I-R low-air-consumption tampers, are identical in overall dimensions, weight, foot-pounds per blow and number of blows per minute with the MT2 tamping tools now in use, their principal departure being a 20 per cent reduction in air consumption due to refinement in design.

The new tamping steels are of the toothed type and have been designed essentially for use in cinder and stone ballast when tamping track raised out of face. In addition to their toothed face, the new steels have a larger face area than the standard steels, that for use in cinder ballast being 5 in. wide and ¾ in. thick, and that for use in stone ballast being 5 in. wide and ⅝ in. thick.

News of the Month . . .

R. F. C. Loans $386,955,308 to Railroads

Cash advances to railroads by the Reconstruction Finance Corporation up to the end of October amounted to $386,955,308, according to the corporation's monthly report. The advances were made to 61 railroads, of which 22 had made repayments amounting to $56,798,796. This includes some repayments by the Railroad Credit Corporation and, in addition, the Pennsylvania had repaid its loan of $28,900,000, the Cincinnati Union Terminal had repaid its loan of $8,300,000 and the Great Northern had repaid its loan of $5,000,000. Total authorizations to 67 railroads or receivers amounted to $411,701,426.

File Code for Motor Buses

A code of fair competition for the motor bus industry, which was filed with the National Recovery Administration by the National Association of Motor Bus Operators, and revised by the administration after numerous conferences and public hearing, has been approved by President Roosevelt and went into effect on November 13. The code provides for wages for bus operators much lower than those paid by railroads, the minimum being $12 to $15 a week, while the rates above the minimum are to be "equitably readjusted." Minimum hours of employment are fixed at an average of 48 hr. a week over a six-week period, with a maximum of 54 hr. a week. All passenger motor carriers are to register their routes with the Motor Bus Code Authority, and those subscribing to the code agree to abide by tariffs of fares to be filed with the code authority.

More Railroads Announce Lower Passenger Fares

Following the announcement by the railroads in the Western district of their intention to reduce the basic passenger rate and to eliminate the Pullman surcharge, on December 1, individual railroads in the east and southeast have also announced lower passenger fares, effective the same date. This action was precipitated by the decision of the Illinois Central to reduce passenger rates between all points throughout its system. To protect its Florida business, the Chicago & Eastern Illinois also reduced its rates to conform to those in the Western district. Then followed in rapid succession announcements by the Seaboard Air Line, the Southern, the Florida East Coast, the Norfolk & Western, the Chicago, Indianapolis & Louisville and the Pennsylvania of reductions in passenger rates, principally between Florida and eastern points. On some lines the coach rate has been reduced to as low as 1½ cents a mile, with a sleeping car rate of 3 cents a mile and no surcharge. Because of these widespread reductions in passenger rates, presidents of the eastern railroads have announced that they will meet in December to reconsider their recent decision to refrain from reducing the basic passenger fare at this time.

M-K-T Records Show Value of Water Treatment

Since the inauguration of a comprehensive water treatment program on the Missouri-Kansas-Texas 10 years ago, locomotive mileage has increased until at present a number of passenger locomotives are averaging more than 400,000 miles between shoppings. More than 80 freight locomotives have 100,000 miles or more to their credit, while a number of heavy freight locomotives have records exceeding 200,000 miles and a few approaching 300,000 miles. Fuel consumption records of this road are equally corroborative of the economy of water treatment. In 1923 passenger service required 1.21 gal. of fuel oil per car mile, while in 1931 this figure was reduced to 0.85 gal. A reduction of 31 per cent in fuel consumption has also been obtained in freight service, while in switching service the decrease was to 21 per cent.

Reduced Rates on L. & N. Boost Passenger Travel

The two-cent passenger rate which the Louisville & Nashville placed in effect for a six months' period from April 1, 1933, to October 1 and then continued until March 31, 1934, is bringing increased business to the road, as shown by a comparison of the traffic for April, May, June and July of this year, with that for the same months in 1932. In the first three months of 1933 passenger traffic on the L. & N. decreased 31.9 per cent below the same period in 1932, while in the next four months, in which the reduced rates were in effect, the decrease in revenues was only 16.8 per cent. In the first three months of the year the number of passengers transported showed a decline of 185,383, or 33.6 per cent, as compared with the same months in 1932. In April, the first month in which the reduced fare was offered, the number of passengers carried increased 29,526 as compared with April, 1932; in May the increase, as compared with the previous year, was 24,449; in June, there was a decrease, because of excursion traffic in June, 1932, of 96 passengers; while in July 54,083 more passengers were carried than in July, 1932. For the four months, the increase in the number of passengers under the new rates was 107,962, or 14.1 per cent.

Wrought Iron Bridge Dismantled after 67 Years of Service

The recent dismantling of a double-track through truss wrought iron bridge of Bollman design on the Baltimore & Ohio marked the end of a structure that had withstood the elements since 1866. The bridge, which carried a spur track across a mill race near Harpers Ferry, W. Va., was originally in main line service, but in 1894 the section of track on which it was installed ceased to be a part of the main line and thereafter functioned only as a spur track. Notwithstanding its age, the abandonment of the bridge was not due to deterioration of its members nor to any inherent defect in design or defect of material or workmanship, but solely to the change in the character of motive power and rolling stock that had taken place since its construction.

New Stainless Steel Train for Texas & Pacific

A light weight two-car gas-electric train of stainless steel has been delivered by the Edward G. Budd Manufacturing Company, Philadelphia, Pa., to the Texas & Pacific, which will operate it between Ft. Worth, Texas, and Texarkana, making a round-trip of approximately 500 miles daily. This is the first completely equipped passenger train of the lightweight stainless steel construction to be placed in long-distance main-line service. The train includes a 15-ft. railway post-office, a 33-ft. baggage and express compartment, and provides seats for 76 passengers in three completely air-conditioned compartments. When completely equipped and ready for service, the train weighs about 104,000 lb. and is driven by two 240-h.p. gas-engine-generator sets. It is designed for a maximum speed of more than 75 miles per hour.

Favorable Trend Again Shown by Carloadings

The trend of railway freight traffic in recent weeks is again showing a more favorable comparison with the corresponding weeks of 1932, following a period extending from the middle of August to the middle of October when the weekly increases in carloadings over last year grew constantly smaller. For the week ending October 21, revenue carloadings showed an increase of only 8,497 cars as compared with the corresponding week in 1932, which was the smallest increase registered since the week of May 13, 1933, when carloadings first showed an increase over the previous year. For the week ending October 28 the increase over the same week in 1932 had risen to 19,390 cars, and for succeeding weeks the following increases over last year have taken place; November 4, 20,483 cars; November 11, 40,989 cars; and November 18, 26,666 cars.

Association News

Roadmasters' Association

At a meeting of the executive committee in Chicago on November 3, the following subjects were selected for investigation and report to be presented at the next convention:

Spot Versus Group Renewal of Crossties
The Conservation of Rail
Highway Crossing Construction
The Cleaning of Stone Ballast
Roadbed Embankment Maintenance

Metropolitan Track Supervisors' Club

The next meeting will be held on Thursday, December 14, at Keen's Chop House, 72 West Thirty-Sixth street, New York City, with a luncheon at 1 p. m. and a business session at 2:30 p. m. The program will include a discussion of the Trackwalker, to be introduced by W. G. Haggerty, supervisor, N. Y., N. H. & H., and a paper on Track Oilers, by D. M. Clark, service engineer, Maintenance Equipment Company.

Maintenance of Way Club of Chicago

Deferred Maintenance—What of it? was the subject of a talk before the club at the Auditorium Hotel, Chicago, on Wednesday evening, November 22, by Elmer T. Howson, editor of *Railway Engineering and Maintenance*. After a brief review of various indices that afford a measure of the extent of deferred maintenance, Mr. Howson discussed the need for an improved standard of track construction to meet the requirements of the more exacting services that the railways are now developing.

The next meeting will be held on the evening of December 20, when C. W. Baldridge, assistant engineer, Atchison, Topeka & Santa Fe, will present a paper on How Rail Budgets Are Prepared.

American Railway Engineering Association

The committees of the Board of Direction on Outline of Work and on Personnel of Committees met at Chicago on November 7, to select the committee members and the subject that will be reported on in 1934.

The Board of Direction, with 17 members in attendance, met at the same place the following day, at which meeting March 13 and 14 were selected as the dates for the 1934 convention. Following the precedent of recent years, the meeting has been shortened to two days, with an evening session the first day and an association luncheon the second day.

Seven committees held meetings in November as follows: Rivers and Harbors, at Chicago, on November 3, with 15 present; Water Service and Sanitation, at Chicago, on November 10, with 15 present; Economics of Railway Labor, at Bethlehem, Pa., on November 14, preceded by an inspection trip over the Lehigh Valley on the previous day, 10 being present; Rail, at New York, on November 16, with 28 in attendance; Ties, at Cincinnati, Ohio, on November 21, with 10 attending; Economics of Railway Operation, at Cleveland, Ohio, on November 24, with an attendance of 12.

Two committees, those on Rail and on Iron and Steel Structures expect to hold meetings in December. The date and place for the former has not yet been decided; the latter will be at Pittsburgh, Pa., on December 7.

Eleven committee reports are now in the hands of the secretary, and a number of others are substantially completed and will be in his hands within a few days.

During the year ending November 15, the A. R. E. A. transverse fissure detector car was operated over 6,600 miles of track. The total number of miles inspected with this equipment during the five years since it was placed in service on November 13, 1928, is 23,181. Through the persistent use of this form of inspection, the number of rails broken in service as a result of transverse fissures has declined sharply year by year, despite the fact that the number of fissures discovered has increased.

International Railway Maintenance Club

At a meeting of the club, at the Hotel Statler, Buffalo, N. Y., on November 16, J. J. Brinkworth, assistant superintendent on the New York Central, presented a paper on The Relation of the Operating Department to the Maintenance of Way Department. A motion picture of the operation of centralized traffic control on the Toledo & Ohio Central lines, was shown by a representative of the General Railway Signal Company.

The following officers were elected for the ensuing year: President, J. R. MacKenzie, district engineer, Canadian National; vice-president, W. H. Newman, signal supervisor, New York Central; and secretary-treasurer, M. B. Morrison, Morrison Railway Supply Corporation.

The Wood-Preservers Association

Ballots have been distributed to the members containing nominations for officers for the next year as follows: For president, S. R. Church, consulting engineer, New York; for first vice-president, F. D. Mattos, manager treating plants, So. Pac., West Oakland, Cal.; for second vice-president, R. S. Manley, president, Texas Creosoting Co., Orange, Tex.; for secretary-treasurer, H. L. Dawson, secretary-treasurer, A. W. P. A., Washington, D. C.

For executive committee, C. S. Burt, superintendent ties and treatment, I. C., Grenada, Miss., and R. E. Meyers, department of chemistry and tests, International Creosoting & Construction Co., Galveston, Tex. Results of the election will be announced at the annual convention which will be held at Houston, Tex., on January 23-25.

Personal Mention

Engineering

H. A. Bertram, assistant division engineer on the Chesapeake & Ohio, with headquarters at Peru, Ind., has been promoted to division engineer at the same point, to succeed **B. V. Davis,** deceased.

Harold F. Tupper, assistant bridge and building supervisor on the Boston & Maine, with headquarters at Concord, N. H., has been promoted to assistant division engineer, with the same headquarters, succeeding **Almon I. Gauthier,** whose death was noted in the November issue. Mr. Tupper was born on January 21, 1899, at Nashua, N. H., and received his higher education at Northeastern University. He entered railway service with the Boston & Maine as a chainman on November 14, 1918, and on May 1, 1920, was promoted to draftsman, with headquarters at Nashua. On September 9, 1925, he was promoted to transitman on the Portland division, and on February 8, 1928, was further advanced to assistant supervisor of bridges and buildings on the same division. On September 16 of the same year he was promoted to assistant engineer, and on July 16, 1929, he was appointed building inspector in the construction department. Later in 1929 he was advanced to resident engineer in the construction department, with headquarters at Claremont, N. H. On March 3, 1931, Mr. Tupper was appointed assistant track supervisor, and on April 1, 1932, he was appointed assistant bridge and building supervisor, with headquarters at Concord, the position he was holding at the time of his recent promotion.

Track

Gustav V. Granlun, extra gang foreman on the Pennsylvania division of the New York Central, with headquarters at Lock Haven, Pa., has been appointed assistant supervisor of track at that point.

H. A. Frederickson, whose promotion to supervisor of track on the New York Central, with headquarters at Pawling, N. Y., was noted in the October issue, has had his headquarters moved to Putnam Junction, N. Y.

T. E. Boyle, welding gang foreman on the Pennsylvania, has been promoted to assistant supervisor of track on the Columbus division, with headquarters at Richmond, Ind., to succeed **T. J. Murray,** who has been transferred.

A. Daugherty, roadmaster of the Fifth district of the Western division of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at Worthington, Minn., has been transferred to the Sixth district, with headquarters at Emerson, Neb., to succeed **B. R. Bitney,** who, in turn, has been transferred to Worthington.

T. G. Mitchell, a transitman on the Canadian Pacific, with headquarters at Sudbury, Ont., has been promoted to roadmaster in charge of the Hamilton-Goderich sub-division, with headquarters at Guelph, Ont., succeeding **J. A. MacKenzie,** whose promotion to division engineer is noted elsewhere in these columns.

W. A. Moberly, a roadmaster in charge of a rail laying gang on the Chicago, Milwaukee, St. Paul & Pacific, has been appointed roadmaster at Chicago, to succeed **A. H. Peterson,** who has been appointed assistant roadmaster at the same point. **C. A. Drawhein,** a roadmaster who has also been in charge of a rail laying gang, has been appointed roadmaster at Janesville, Wis., succeeding **W. H. Armstrong,** acting roadmaster, who has been appointed roadmaster at Aberdeen, S. D., Mr. Armstrong succeeds **L. W. Winfrey,** who has been assigned to other duties.

F. M. Corbett, acting supervisor of track on the Grand Trunk Western, with headquarters at Valparaiso, Ind., has been promoted to supervisor of track, with the same headquarters to succeed **John Nolan,** who has retired because of ill health. Mr. Corbett was born on November 9, 1881, at Wilmington, Ill., and entered railroad service in the road department of the Chicago & Alton in 1898. Five years later he was advanced to supervisor of track and in 1909 he was transferred to the operating department as a trainmaster. In 1911 Mr. Corbett returned to the maintenance department as a roadmaster, which position he held until 1914 when he went with the Chicago Great Western as a roadmaster at Rochester, Minn. In 1916 he was appointed trainmaster with headquarters at Red Wing, Minn., being transferred to St. Paul, Minn., in 1922. Mr. Corbett left this company in August, 1923, to go with the Baltimore & Ohio Chicago Terminal as a yardmaster, leaving this company in the following year to enter the service of the Grand Trunk Western as an extra gang foreman. He was promoted to general foreman in 1926, which position he held until his appointment as acting supervisor of track on April 16, 1933. Mr. Corbett's appointment as supervisor of track became effective on November 1.

R. C. Campman, assistant supervisor of track on the River division of the New York Central, with headquarters at Weehawken, N. J., has been promoted to supervisor of track on the Pennsylvania division, with headquarters at Lock Haven, Pa., succeeding **J. W. Dahl,** whose death on October 29 is noted elsewhere in these columns. Mr. Campman is succeeded at Weehawken by **Frank B. Cox,** formerly extra gang foreman at Newburgh, N. Y.

Mr. Campman, who was born at Wallaceton, Pa., on March 26, 1889, started his railway career as a track laborer on the New York Central at Woodland, Pa., on July 13, 1907. On April 15, 1909, he was promoted to section foreman at Stark, Pa. Until January 1, 1926, he held the positions of section foreman, work train foreman and extra gang foreman at various points, and on the latter date was appointed assistant supervisor of track on the Pennsylvania division, at Lock Haven. Later he was transferred to the Adirondack & Ottawa division, with headquarters at Moira, N. Y., and on June 1, 1928, he was transferred to Weehawken, where he was located at the time of his promotion to supervisor.

William Flynn, formerly an assistant roadmaster on the Chicago & North Western and more recently a track foreman and extra gang foreman at Escanaba, Mich., has been promoted to roadmaster on the Lake Shore division, with headquarters at Fond du Lac, Wis., succeeding **A. W. Tabert,** who has been transferred to the Madison division, at Madison, Wis. Mr. Tabert replaces **F. Maso,** whose death is noted elsewhere in these columns.

Mr. Flynn was born on March 7, 1889, at Negaunee, Mich., and entered the service of the Chicago & North Western in 1905, serving as a track foreman and extra gang foreman until December 24, 1929. At that time he was promoted to assistant roadmaster, with headquarters at Stambaugh, Mich. Mr. Flynn's promotion to roadmaster at Fond du Lac became effective on November 20.

Bridge and Building

George E. Luther, scale inspector on the Boston & Maine, has been promoted to chief scale inspector, with headquarters at Boston, Mass., succeeding **L. H. Gordon,** who died on October 30.

Clarence A. Little, carpenter foreman on the Boston & Maine, has been promoted to assistant supervisor of bridges and buildings on the New Hampshire division, with headquarters at Concord, N. H., to succeed **Harold F. Tupper,** whose promotion to assistant division engineer is noted elsewhere in these columns.

W. H. Cochran has been appointed supervisor of bridges and buildings on the Missouri Pacific, with headquarters at Jefferson City, Mo., to succeed **William Hausgen,** who has retired. Mr. Cochran was born on July 21, 1881, at Bellefonte, Ark., and entered railway service on July 1, 1903, with the Missouri Pacific. He served in various positions in the engineering, construction and bridge and building departments until his recent promotion to supervisor of bridges and buildings, which became effective on November 16.

Obituary

L. H. Gordon, chief scale inspector on the Boston & Maine, with headquarters at Boston, Mass., died on October 30, as a result of a heart attack. Mr. Gordon was born on June 23, 1872, at Sutton, Vt. He entered the employ of the Boston & Maine on April 26, 1905, as a carpenter, and was subsequently promoted to carpenter foreman and scale repairman. On October 1, 1923, he was promoted to the position of scale supervisor for the system, and on April 1, 1927, was made chief scale inspector for the system, the position he was holding at the time of his death.

Theodore T. Lowdermilk, master carpenter on the Pennsylvania, with headquarters at Williamsport, Pa., died on November 1 as the result of a gun shot received while hunting. Mr. Lowdermilk was born at Dalbysport, Md., on March 31, 1876, and entered railway service on January 24, 1906, as a carpenter on the Pittsburgh division of the Pennsylvania. In 1910 he was promoted to carpenter foreman on the same division, and in February, 1915, he was promoted to assistant master carpenter, with headquarters at Renovo, Pa. In April, 1917, he was promoted to master carpenter with headquarters at Sunbury, Pa., and in 1921, was transferred to Williamsport, Pa., where he was located at the time of his death.

J. W. Dahl, supervisor of track on the Pennsylvania division of the New York Central, with headquarters at Lock Haven, Pa., died at his home in Lock Haven on October 29. Mr. Dahl, who was born in Sweden on July 26, 1870, started his railway career as a track laborer on the New York Central, at Gorton, Pa., on July 7, 1892, and was promoted to section foreman at that point on August 1, 1897. Subsequently, he served as extra gang foreman at Lock Haven, section foreman at Munson, Pa., and work-train foreman at Lock Haven, and in March, 1902, he was appointed tie inspector on the Beech Creek district, with headquarters at Beech Creek, Pa. Later he served as work-train foreman and general foreman at Lock Haven, and on May 1, 1907, was appointed supervisor of track at that point, which position he was holding at the time of his death.

I. D. Waterman, assistant chief engineer of the New York, New Haven & Hartford at the time of his retirement on October 1, 1929, because of ill health, died at New Haven, Conn., on October 30. Mr. Waterman was born at South Weymouth, Mass., on February 18, 1879, and received his higher education at Lowell Institute and Massachusetts Institute of Technology. He entered railroad service with the Boston & Albany in September, 1899, serving as rodman, inspector and instrumentman, respectively, until May, 1902, when he left railway service. In February, 1904, Mr. Waterman returned to the New Haven as instrumentman at New Rochelle, N. Y. In June, 1907, he was made assistant engineer of construction, and in May, 1912, was promoted to engineer of construction. On July 1, 1923, Mr. Waterman was placed in charge of all construction work on the system and his title was changed to assistant to chief engineer. In July, 1925, he was promoted to assistant chief engineer, which position he retained until October 1, 1929, when he was granted a leave of absence.

Morton L. Byers, consulting engineer on the Delaware & Hudson from 1911 to 1923, and chairman of the Valuation committee of the Seaboard Air Line from 1914 to 1925, died at his home in East Orange, N. J., on November 24, at the

THE **REASON** FOR THE EVER INCREASING DEMAND FOR **WOODING RAIL ANCHORS?**

A CAREFUL ANALYSIS OF **WOODING RAIL ANCHOR PERFORMANCE** REVEALS THESE FACTS:–

- LOWEST COST
- HIGHEST REAPPLICATION VALUE
- LOWEST COST TO APPLY
- HIGHEST RESISTANCE TO SLIPPING
- **METHOD OF APPLICATION PREVENTS DAMAGE TO ANCHORS OR RAIL**

WOODINGS FORGE & TOOL CO.

WORKS AND GENERAL OFFICES

VERONA, PENNA.

age of 65. Mr. Byers, was born at Mauch Chunk, Pa., on March 22, 1868. After graduating from Lehigh University, he entered railway service as assistant engineer maintenance of way on the Erie & Ashtabula division of the Pennsylvania and in May, 1891, he became assistant engineer on the Pittsburgh, Cincinnati, Chicago & St. Louis (now part of the Pennsylvania). In April, 1893, he was promoted to engineer maintenance of way and in January, 1902, he became chief engineer maintenance of way of the Baltimore & Ohio, later being appointed assistant to the general manager and then assistant general superintendent of transportation. In January, 1905, he was appointed chief engineer maintenance of way of the Missouri Pacific Lines. In June, 1911, he became consulting engineer on the Delaware & Hudson, and in 1914 he assumed the additional position of chairman, Valuation committee, Seaboard Air Line. He relinquished his position on the Delaware & Hudson in 1923, and his position on the Seaboard Air Line in 1925, later to become president of the West Virginia Malleable Iron Company.

John D. Farrell, who retired from railroad service in 1926 as vice-president of the Oregon-Washington Railroad & Navigation Company and who was formerly connected with the maintenance departments of a number of railroads in the United States and Canada, died on November 16 at Los Angeles, Cal., at the age of 77 years. Mr. Farrell first entered railway service in 1877 as a trackman on the Chicago & North Western. Two years later he went with the Chicago, Milwaukee, St. Paul & Pacific where he served as a timekeeper, foreman of material yard and foreman of bridges, buildings and water service. In July, 1882, he joined the Canadian Pacific where he served as foreman of bridges, buildings and water service and assistant superintendent of bridges, buildings and water service as well as in other capacities in train and station service. In later years Mr. Farrell served in the operating departments of the Chicago Great Western, the Great Northern and the Oregon-Washington Railroad & Navigation Company, being vice-president of the latter company at the time of his retirement.

Automatically Maintained Pressure Regulators.—The Air Reduction Sales Company, New York, has published an attractively printed leaflet describing and illustrating its new two-stage reduction oxygen regulators and acetylene regulators for use in oxy-acetylene welding.

Supplement to Pocket Companion.—The Carnegie Steel Company, Pittsburgh, Pa., has issued a supplement to the abridged edition of its Pocket Companion, which is devoted almost entirely to tables of dimensions and other information regarding CB sections. This catalog supersedes all information relating to these sections given in prior publications. It contains the properties and all official detailed dimensions of the modified CB series, the changes in this series being incidental to full standardization with other makers of wide-flange beams.

Supply Trade News

Roberts and Schaefer Company, Chicago, announce the retirement on November 14, of **Clyde P. Ross,** vice-president in charge of its railroad department, and **David E. White,** contracting manager in the railroad department. The company will continue its railroad department, covering the design and construction of coaling stations, cinder and sand handling plants, car washing plants, and accessories, through its general offices in Chicago and branches in Pittsburgh, Pa., Huntington, W. Va., and Denver, Colo., as in the past.

The Gale Service & Construction Company, Chicago, has organized a separate department to engage in the building up of battered rail ends, and the repair of crossings, frogs, etc., by welding, and has placed **C. O. Hunt** in charge. Mr. Hunt was employed from 1905 to 1913 on location, construction and maintenance by the Chicago, Burlington & Quincy. After engaging in private business for three years he then entered the employ of the Ajax Forge Company, Chicago, later a part of the Ramapo Ajax Corporation, as an inspector, relief foreman, and for six years prior to 1928, as superintendent of the Chicago plant. Following another year in the engineering department of the Burlington, he entered the service of the Electric Railweld Sales Corporation, Chicago, in 1930, with which company he was employed until May, 1933, as field superintendent.

C. O. Hunt

Clyde P. Ross, and **David E. White,** who have severed their connection with Roberts and Schaefer Company, as noted elsewhere in these columns, have organized the **Ross and White Company,** with offices in the Daily News building, Chicago, to engage in the designing and building of railroad locomotive coal, sand and cinder plants, and equipment for use in such facilities. **Glen O. Morford,** who has been in charge of design in the railroad department of Roberts and Schaefer Company for the past 13 years has resigned to become chief engineer of the new company.

Mr. Ross was born at Rockford, Ill., on December 3, 1882, and obtained his first experience in coal handling facilities when he entered the designing department of the Link Belt Company, Chicago, in 1901. On March 15, 1904, he severed his connection with that company to enter the employ of Roberts and Schaefer Company. Subsequently, he served as chief draftsman and contracting engineer, and for the last 13 years as vice-president and director. Mr. White was born at Cottage Grove, Tenn., on July 30, 1889, and graduated from the College of Engineering of the University of Tennessee in June, 1912. Following his graduation he was employed for several years in the engineering department of the Louisville & Nashville, and in April, 1917, entered the service of the Roberts and Schaefer Company in its engineering department, being later made contracting engineer.

Trade Publications

Construction Work in Winter—The Portland Cement Association, Chicago, has published a 12-page folder entitled "Doing Your Part This Winter," presenting a plea to carry on construction work at active levels during the winter months in order to stimulate employment. The folder contains complete specifications for making, placing and curing concrete in winter.

Carnegie Controlled Carbon Steels—The Carnegie Steel Company, Pittsburgh, Pa., has issued a booklet of 62 pages which contains a comprehensive discussion of the control of quality factors in the manufacture of steel by the basic or open hearth process. The booklet, which is attractively illustrated and printed, is divided into five principal parts as follows: (1) Carbon Steel Quality Factors and the Need for Control; (2) Some Carbon Steels Manufactured by the Carnegie System of Control—Physical Properties of Different Types after Heat Treatment; (3) Importance of Controlled Steel Making to the Steel Consumer; (4) The Carnegie System for Controlling Quality Factors; and (5) A Classified Bibliography.

Results with No-Ox-Id—A comprehensive booklet entitled "Proof of Results with No-Ox-Id in the Railroad Field" has been issued by the Dearborn Chemical Company, Chicago. This 28-page booklet, shows the wide range of railway uses for this chemically-compounded rust preventive. Numerous applications to such facilities as water tanks, bridges, rail bonds, stored pipe, etc., are illustrated and described. The various adaptations of No-Ox-Id Protection in the form of (1) a compound, made in various consistencies for industrial conditions; (2) an impregnated wrapper covering for use under special conditions; (3) fillers and paint primers; and (4) quick-drying protective coatings for specialized interior and exterior use, are described in the booklet, which also contains a partial list of the railroads that have used this protection in one form or another.

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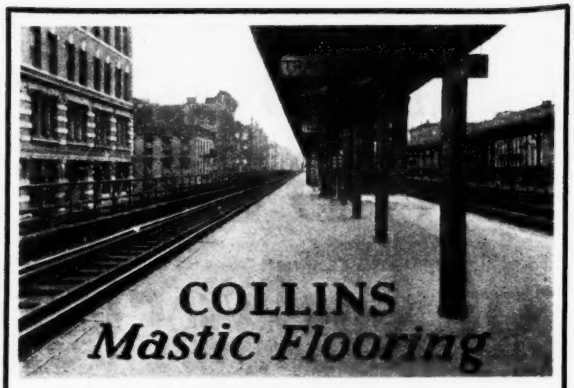

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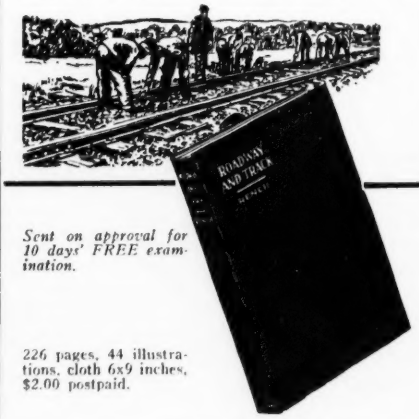

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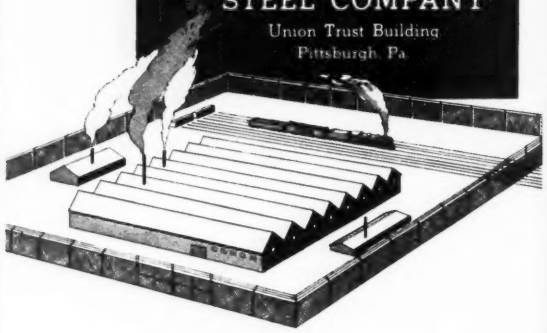

Pittsburgh Fence

Freedom From Insects

Bedbugs, lice, fleas and other insects are present wherever man lives, and their complete eradication throughout the world is a sheer impossibility.

It is, however, possible to exterminate all such pests in camp cars and other railroad facilities through the application of Railroad Calcyanide, which liberates a gas that diffuses throughout the structure and penetrates all articles of bedding and clothing. Then, by practicing cleanliness, reinfestation may be prevented for a long period of time, if not indefinitely.

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Many railroads use Railroad Calcyanide.

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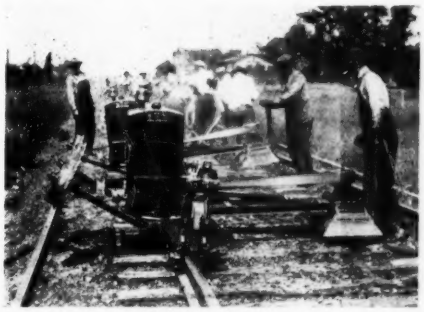
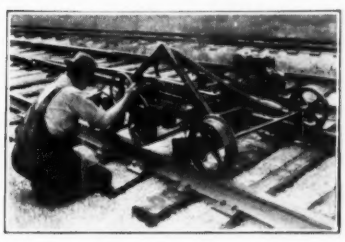
Here are the tools that have won first place for NORDBERG in the maintenance field



Adzing Machine

Spike Puller

Power Jack



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When thinking of the improved quality of track, which can be secured today at less expense, it is natural to think of the tools developed by Nordberg for maintenance work. On all prominent roads they are standard equipment for rail laying and reconditioning work.

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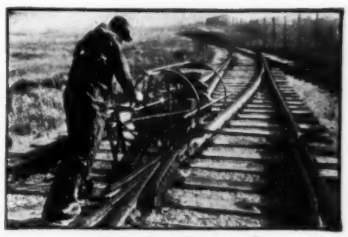

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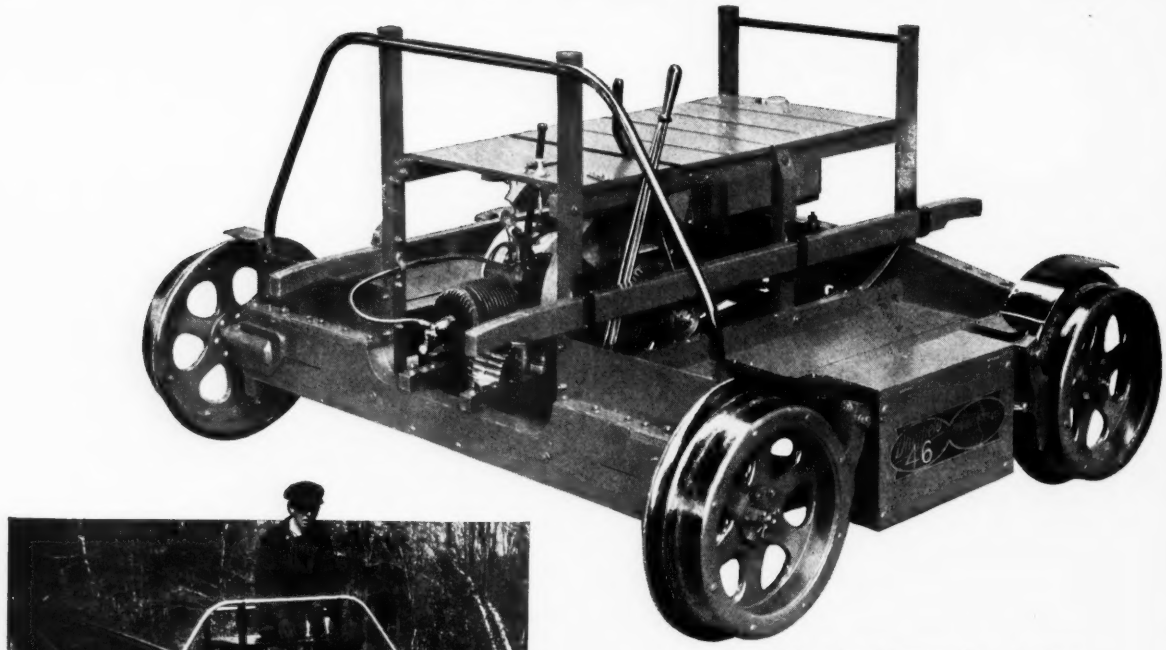

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